EFFECTS OF RAPID CANINE DISTALIZATION THROUGH DISTRACTION OF PERIODONTAL LIGAMENT USING SINGLE MID-PALATAL DISTRACTOR AND COMPARING BONE DENSITY OF DISTRACTED SEGMENT BY CONE BEAM COMPUTED TOMOGRAPHY (CBCT)

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MASTER OF DENTAL SURGERY

BRANCH - V
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CERTIFICATE

This is to certify that the dissertation entitled **“Effects of Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT)”** by **Dr. RIZWAN AHMED ABDUL KALAM** Post graduate student (M.D.S), Orthodontics (branch V), Tamil Nadu Govt. Dental College and Hospital, Chennai, submitted to the Tamil Nadu Dr. M.G.R. Medical University in partial fulfilment for the M.D.S. degree examination (April 2013) is a bonafide research work carried out by him under my supervision and guidance.

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DECLARATION

I, **Dr. RIZWAN AHMED ABDUL KALAM** , do hereby declare that the dissertation titled "***Effects of Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT).***" was done in the Department of Orthodontics, Tamil Nadu Government Dental College & Hospital, Chennai 600 003. I have utilized the facilities provided in the Government Dental College for the study in partial fulfilment of the requirements for the degree of Master of Dental Surgery in the speciality of Orthodontics and Dentofacial Orthopaedics (Branch V) during the course period 2010-2013 under the conceptualization and guidance of my dissertation guide, Professor **Dr. M. C. Sainath, MDS**.

I declare that no part of the dissertation will be utilized for gaining financial assistance for research or other promotions without obtaining prior permission from the Tamil Nadu Government Dental College & Hospital.

I also declare that no part of this work will be published either in the print or electronic media except with those who have been actively involved in this dissertation work and I firmly affirm that the right to preserve or publish this work rests solely with the prior permission of the Principal, Tamil Nadu Government Dental College & Hospital, Chennai 600 003, but with the vested right that I shall be cited as the author(s).

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Signature of the Head of the Institution

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I seek the blessings of the Almighty God without whose benevolence; the study would not have been possible.

TRIPARTITE AGREEMENT

This agreement herein after the “Agreement” is entered into on this day............... day of December 2012 between the Tamil Nadu Government Dental College and Hospital represented by its **Principal** having address at Tamilnadu Government Dental college and Hospital, Chennai-03, (hereafter referred to as , ’the college’)

And

Dr. M. C. Sainath aged 55 years working as professor at the college, having residence address at Block ‘U’, Door no 11,4th main road, Annanagar, Chennai 600040, Tamilnadu (herein after referred to as the ‘Principal investigator’)

And

Dr. RIZWAN AHMED ABDUL KALAM aged 27 years currently studying as postgraduate student in department of Orthodontics in Tamilnadu Government Dental College and Hospital (herein after referred to as the ‘PG/Research student and co- investigator’).

Whereas the ‘PG/Research student as part of his curriculum undertakes to research on “**Effects of Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT)**” for which purpose the PG/Principal investigator shall act as principal investigator and the college shall provide the requisite infrastructure based on availability and also provide facility to the PG/Research student as to the extent possible as a Co-investigator.

Whereas the parties, by this agreement have mutually agreed to the various issues including in particular the copyright and confidentiality issues that arise in this regard.

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9. If any dispute arises as to the matters related or connected to this agreement herein, it shall be referred to arbitration in accordance with the provisions of the Arbitration and Conciliation Act, 1996.

In witness whereof the parties hereinabove mentioned have on this the day month and year herein above mentioned set their hands to this agreement in the presence of the following two witnesses.

College represented by its **Principal** **PG Student**

Witnesses **Student Guide**

1.

2.

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LIST OF ABBREVIATION

DO- Distraction osteogenesis

PD- Periodontal distraction

DAD- Dentoalvelolar distraction

CBCT- Cone beam computed tomography

OPG- Orthopantamography.

UROr - the most inferior and lateral point of upper right orbit.

ULOr- the most inferior and lateral point of upper left orbit

ABSTRACT

Objectives: The objectives of this study were to achieve rapid canine distalization through periodontal distraction method using single mid-palatal distractor in first premolar extraction cases with maxillary canine buccally inclined, to evaluate the displacement of the canine and first molar teeth and to compare bone density pre distraction and 3 months after distraction using cone beam computed tomography (CBCT). **Materials and Methods:** The sample of the study consisted of 20 teeth in ten patients (eight females and two males). Pre and post-treatment dental casts, panoramic radiographs, and standard periapical radiographs were taken from all patients. An electrical vitality test was applied before and after the distraction procedure and during the follow-up period. In addition, CBCT was used to evaluate bone density pre and 3 months after distraction to assess maturation of distracted segment **Results:** The distraction procedure was completed in 15 to 18 days (mean 16.7±1.06). The anchorage loss ranged from 0 mm to 2mm (mean 0.7 ± 0. 67). The rate of canine retraction range from 0.38mm/day to 0.56mm/day (mean 0.469±0.046). The canines showed a mean ($11.71^0 \pm 3.47^0$) of distal tipping. There was no statistically significant change in bone density pre and 3 months after distraction. **Conclusion:** In this study, addition to enumerable advantage, Mid-palatal distractor showed comparable results with buccal distractor in buccally inclined canine cases. Palatal distractor has opened the opportunity to select the type of distractor according to individual cases and treatment plan. We believe that rapid canine distalization using palatal distractor will become a routine protocol and a popular method among orthodontic applications in future.

KEY WORDS: Distraction osteogenesis, periodontal distraction, Mid-palatal distractor.

The goal of orthodontic treatment is to improve the quality of patient's life through enhancement of dentofacial functions and esthetics. Orthodontic tooth movement is a process wherein a mechanical force is applied to induce alveolar bone resorption on the pressure side and alveolar bone deposition on the tension side. On the tension side periodontal ligament is stretched (distracted) followed by alveolar bone deposition (osteogenesis). Prolonged duration of orthodontic treatment is a major concern for both the patients as well as the Orthodontist. Reducing the treatment duration by accelerating the tooth movement with minimal damage to the periodontal structure is particularly important in adults. Periodontal or dentoalveolar distraction of canine has shown promising results in achieving rapid space closure by augmenting the tooth movement in orthodontic treatment procedures.

Distraction osteogenesis (DO), which has been used for over a century, induces the formation of new bone between bony segments of the corticotomized long bone through distracting them away from each other gradually. Alessandro Codivilla (1905) is credited with refinements in the procedure of distraction osteogenesis. The technique of distraction osteogenesis was popularized by Russian physician Gavriel A. Illizarov[17], who has been involved with the comprehensive use of this technique to regenerate bone and soft tissues. On craniofacial skeleton, Snyder et al (1973)[43] described the first report of distraction osteogenesis in a canine mandible followed by, McCarthy et al (1992)[30] who published the first clinical reports of mandibular ramus lengthening by gradual distraction with the use of an extra oral distraction device in a hemimicrosomia patient. In 1976, Michieli and Miotti[31] reproduced Snyder's work, using an intraoral device. Since then, distraction osteogenesis has been applied to all the bones of the craniofacial skeleton, including the midface and maxilla. A common Distraction osteogenesis modality utilized in rapid palatal expansion in maxillofacial deformities involves a suture. It has been discovered that the periodontium is more active than median palatine suture, indicating that the periodontal ligament possesses a greater potential for new bone formation through Distraction osteogenesis. The technique is successful in the rapidly retraction of canines within weeks.

In 1998, Liou and Huang[28] used a distraction device attached to the teeth for rapidly moving the canines after surgical intervention. Their approach relied on the periodontal ligament to move the canines distally in 3 weeks. A few years later, Kisnisci et al[28] introduced dentoalveolar distraction, a more invasive surgical approach based on osteotomies around the teeth, to move the segment of bone containing the canines distally. Iseri et al[18] used the same approach to move canines distally at the rate of 1 mm per day in 8 to 14 days.

Cone beam computed tomography (CBCT) has been used as an important diagnostic tool in the study of rapid canine retraction. It allows the accurate determination of alveolus deepening in order to completely eliminate any interference with canine movement. It also provides an accurate assessment of sinus and nasal floor proximity so that any complications are avoided during the surgical procedure. It is considered as a vital tool for evaluation of bone density of normal or pathological bone and in addition, it is useful in evaluation of relapse tendency of distracted segment after distraction of canine[35]

According to the original research which was done by Liou and Huang, and confirmed by other researchers, canines experience a measurable inclination, extrusion, proclination and distal rotation during distalization through buccal access. This can be confirmed by both panoramic radiographs and Cone-Beam computed tomography. In order to avoid proclination of the maxillary canines during rapid canine retraction in cases where canines are well positioned in the buccopalatal direction, or else to move them into the alveolar process in cases where they are initially proclined, palatal distractor can been used[35]. Liou and Huang demonstrated that after distraction, newly created bone becomes radiographically mature in 3 months[28]. The present study was undertaken to clinically evaluate the effect of rapid canine distraction through distraction of periodontal ligament using single palatal distractor and comparing bone density of the distracted segment before and after 3 months of distraction by cone beam computed tomography (CBCT).

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AIM:

To evaluate the effects of rapid canine distalization on dentoalveolar tissues during rapid distalization of canine teeth with single mid-palatal tooth borne distractor and to compare and evaluate the bone density of the distracted segment after 3 month with cone beam computed tomography (CBCT)

OBJECTIVES:

1. To determine the rate and duration of canine retraction with single mid palatal distractor.
2. To determine the change in angulation of canine teeth
3. To determine anchorage loss of molars
4. To determine the bone density between lateral and canine in maxillary arch predistraction and after 3 month of distraction with CBCT

K. Reitan (1957)[23] conducted and concluded that during the initial stage of a tipping tooth movement performed with continuous forces, cell-free, compressed areas are frequently created on the pressure side of the root even if the force applied is light. The time required for elimination of the compressed area by indirect bone resorption varies from around two weeks up to three or four weeks, occasionally longer. The duration of an indirect resorption process is influenced by the length of the root, a short root being likely to entail a longer period of hyalinization. Intermittent forces of around 70 to 100 grams may produce hyalinized areas on the pressure side of the tooth moved, but of a shorter duration than in a continuous tooth movement. The force exerted in a tipping movement performed with continuous forces will create compressed, cell-free areas in the periodontal membrane more frequently than in a bodily movement, because of the mechanical principles involved. Direct resorption was observed in a torquing movement exerting 130 grams of pressure in the apical region.

K. Reitan (1960)[24] summarized in his study that, contraction of fibrous structures after tooth movement must be considered a normal tissue reaction. After a tipping movement this contraction may produce compressed cell-free areas on the traction sides. The ensuing undermining bone resorption may increase the relapse tendency. The mechanics involved in a bodily movement tend to favour a direct bone resorption on the pressure side. Following rotation, tension and displacement of supra-alveolar structures may persist even after retention. Early treatment or over rotation may, to a large extent, prevent relapse tendencies.

K. Reitan(1964)[22] conducted a study on structures of 54 human teeth in 11 to 12-year-old persons revealed a tendency to bone density, i.e., few had small marrow spaces, in six cases. A dense alveolar bone is more common in animals such as the dog, notably in the labial and lingual bone walls. Experiments, imitating the effect elicited by an extra-oral appliance, revealed that the contact established with the neighbouring tooth and the additional thickness of the band material would prevent hyalinisation. Semi-hyalinisation had taken place on the pressure side. A considerable movement of the tooth moved, as well as of the tooth situated distally to the experimental tooth, had occurred. As a result of a reverse move-ment during the rest periods, pressure had been exerted on the tension side whereby new bone lamellae had become slightly curved.

Cleall JF, Bayane DJ, Posen JM, Subtelney JD (1965)[8] investigated effects of strong expansion forces on the mid-palatal suture in the rhesus monkey. There was disruption of the mid-palatal suture leading to increase in width of the maxillary arch. The resultant bony defect is rapidly and completely healed with the restoration of the normally growing suture.

Charles G. Sleichter(1971)[6] in their study concluded that a speculation that continuous forces of less than 200 grams could move canines without moving posterior anchorage is in order. Inclusion of first and second molars and second bicuspids may be necessary to overcome the canine resistance. The long rooted canine may have as much resistance to movement as a molar and bicuspid. A long acting continuous source of energy is most important in efficient space closure. Cuspid to cuspid compressed coil springs are a very efficient, long acting source of energy. Teeth moved along an archwire of adequate size do not tip excessively, particularly when brackets are inclined for controlled movement. Pain is apparently related more closely to patient tolerance than to the forces used.

Grimm FM(1972)[14] conducted a study to determine whether intraseptal bone deformation is detectable and of a magnitude sufficient to contribute to the rapid initial tooth movement observed clinically in orthodontics. Only the effect of tipping tooth movement was studied within the range of forces used in conventional orthodontics. It was concluded that bending at the crest occurs with forces within the range used by conventional orthodontic appliances. Alveolar deformation represented as little as 0.6 per cent to as high as 25 per cent of total tooth movement. Loosening up is a feature with repeated activations, although the magnitude of bone deflection levels off after permanent deformation results in a widened ligament space

Snyder CC, Levine GA, Swanson HM, Browne EZ Jr. (1973)[43] reported about the potential application of distraction osteogenesis to the craniofacial region and treated an artificially created cross bite in a dog using external fixators.

Michellis S, Miotti B (1977)[31] were able to achieve lengthening of the mandibular body in two dogs with a technique that involved osteotomies and the use of an experimental orthodontic appliance; the approximation of the resected mandibular segments was maintained. There was no damage to the mandibular nerve and no conspicuous alterations of the nerve fibers. They were able to lengthen the mandibular body in 2 days by 0.5-1.5cm. The important aspect of this study was the use of intraoral distraction device attached to the mandibular dentition and he demonstrated that the mandibular teeth could be used to anchor the distraction device.

Carlos Ayala Perez et al (1980)[5] analyzed the distribution of force transmitted to the alveolar bone and surrounding structure by means of photo elastic visualization, utilizing J-hook headgear for maxillary canine retraction. A three-dimensional photo elastic model was reproduced from a human skull to permit an analysis of the effects of forces. Three different vectors of force, representing high, medium and low-pull headgear were applied. They concluded that High-pull headgear produced the least tipping effect during canine retraction

Rolf Berg And Urs Gebauer(1982)[38] analyzed spontaneous changes of tooth position during the 6 months following first premolar extractions in the lower arch in 21 cases with marked crowding of the lower incisor segment. The arcogramme technique (Herren et al. 1973) was used for the measurements. The extraction sites were reduced by about 50% on average but there was considerable individual variation. About 80% of the space reduction resulted from distal drifting of the canines. Varying degrees of rotation of the canines and second premolars were observed, but this was not related to the positions of the teeth before treatment. An increase of the intercanine distance was observed in the majority of cases. They concluded that spontaneous changes following first premolar extractions in the lower arch may be utilized for therapeutic purposes but because of the individual variability careful supervision of the post-extraction development is essential.

Ilizarov GA (1989)[17] assessed the influence of both the rate and the frequency of distraction on osteogenesis during limb elongation, a canine tibia was used with various combinations of distraction rates (0.5 mm, 1.0 mm, or 2.0 mm per day) and distraction frequencies (one step per day, four steps per day, 60 steps per day). The distractions were performed after both open osteotomy and closed osteoclasis. Histomorphic and biochemical studies were conducted on the elongated osseous tissue, fascia, skeletal muscle, smooth muscle, blood vessels, nerves, and skin. It was determined that distraction at a rate of 0.5 mm per day often led to premature consolidation of the lengthening bone, while a distraction rate of 2.0 mm per day often resulted in undesirable changes within elongating tissues. A distraction rate of 1.0 mm per day led to the best results. It was also observed that the greater the distraction frequency, the better the outcome. With optimum preservation of periosseous tissues, bone marrow, and blood supply at the time of osteotomy, stability of external fixation, and 1.0 mm per day of distraction in four steps, osteogenesis within the distraction gap of an elongating bone takes place by the formation of a physeal like structure, in which new bone forms in parallel columns extending in both directions from a central growth zone. The growth plate that forms under the influence of tension-stress has features of both physeal and intramembranous ossification, yet is neither; instead, the distraction regenerated bone is unique, providing numerous applications in clinical traumatology, orthopedics, and other medical disciplines.

McCarthy JG, Schreiber J, Karp N, Thorne CH, Grayson BH (1992)[30] demonstrated the clinical applications of distraction osteogenesis by presenting case reports of four children with congenital craniofacial anomalies. Bone division was initiated with a series of bicortical drill holes placed along the osteotomy line, which were connected by a 3 mm osteotome. Lengthening began after 7 days of latency at a rate of 1mm per day. After 18-24 days of distraction, extended fixation was maintained for additional 8-10 weeks.

Block M, Daire J, Stover J, Mathews M (1993)[3] used distraction osteogenesis to investigate the ultra structural changes of inferior alveolar nerve and found that bone continuity was re-established along with the maintenance of nerve function.

Block M, Brister G (1994)[2] did a pilot study to find out the potential of using the principles and techniques of distraction osteogenesis for advancement of the maxillary bone, an intra-oral distraction device consisting of a jack – screw appliance was connected anteriorly to orthodontic bands fitted on the canines and posterior to two abutment heads of two implants placed one on either side of the arch. Soft and hard tissue formation resulted complete healing across the distraction gap without a soft tissue defect. This study showed for the first time that distraction osteogenesis can be successfully applied to the maxilla by using an Intra-oral distraction device.

Daskalogiannakis J and Mclachlan K.R (1996)[9] studied the rate of tooth movement on the two sides was compared over a period of 3 months, on the basis of maxillary impressions taken at frequent intervals during the course of the study. The canines retracted with a constant force moved statistically significantly more than the control canines ($p < 0.05$) during the experimental period. The average differences in the mean rates of tooth movement between the two sides were in the order of 2:1 in favor of the experimental side. There were no statistically significant differences in the changes of angulation (tipping) or rotation about the y axis between the two sides. The duration of force application seems to be a critical factor in regulating rate of tooth movement. Conversely, magnitude of the applied force did not appear to be of primary significance.

Jack J.G.M(1996)[19] demonstrated that, on application of orthodontic force, there was an initial minimal tooth movement produced due to movement of the tooth within its socket. This was followed by a period of no tooth movement probably associated with hyalinization of the periodontal ligament. This phase lasted up to a maximum of 35 days and was independent on the applied force magnitude. No significant difference was found either in the rate of tooth movement or amount of anchorage loss, when forces of 50,100 and 200 grams were used.

M. Ali Darendeliler, Haluk Darendeliler, And Oktay Üner(1997)[29] tested the clinical use of a new spring, the drum spring (DS) retractor that applied a constant and continuous force without the need for reactivation. They also compared the effect of the drum spring retractor and a traditional pull coil retractor system on the rate of upper canine retraction in a sample of 15 patients. The DS retractor was successful without any reactivation, and the traditional pull coil system provided a more rapid canine movement. Canine retraction occurred faster in adolescent than in adults.

Rudolf Hasler, George Schmid, Bengt Ingervall, And Urs Gebauer (1997)[39] compared the rate of maxillary canine retraction into healed and recent extraction sites, using Gjessing retraction springs. They concluded that the canine on the recent extraction side moved faster than that on the healed side, but also tipped somewhat more. They say that this might be due to the insufficient movement to force ratio of the spring, since the center of resistance of the tooth might be located further apically and bone distal to canine being denser near the apex than the marginal area.

Weil TS, Vansickels JE, Payne J (1997)[47] carried out for the first time distraction osteogenesis to correct transverse deficiencies in the mandible using orthodontic distraction devices. Nine patients with congenital/developmental maxillofacial skeletal deformities had distraction osteogenesis performed. All patients had study cast and cephalometric and dental radiographs obtained before and after surgery. Eight of nine patients also had simultaneous surgical assisted-rapid palatal expansion (SARPE). The other patient had nonsurgical rapid palatal expansion. The appliance was placed after symphyseal osteomy and a latency period of 4-5 days. The appliance was activated 3 times a day for a total of 0.75 mm /day. Radiographic data showed completed bone formation at the distracted site in a period of three months. These pre-liminary results showed that distraction osteogenesis is a viable option to correct transverse discrepancies of the mandible.

Yamamoto H, Block M (1997)[48] used six adult dogs to study a new technique for distraction osteogenesis in the maxilla. 4 titanium implant were installed in the maxillary alveolar bone, 2 anteriorly and 2 posteriorly. A midline screw oriented anterior-posteriorly was connected to the respective abutments. Distraction was carried out at a rate of 1 mm/day to obtain a 10 mm elongation. Morphological, radiographic and histological examination showed successful distraction with almost complete intra – membranous formation.

Liou EJW and Shing Huang (1998)[28] proposed a new concept of distracting the periodontal ligament to elicit rapid canine retraction in 3 weeks. They called the term 'Dental Distraction" for this procedure. At the time of first premolar extraction, the interseptal bone distal to the canine was undermined with a bur, grooving vertically inside the extraction socket along the buccal and lingual sides and extending obliquely towards the socket base. Then a tooth-borne, custom-made intra-oral distraction device was placed to retract the canine into the extraction space. Both upper and lower canines were distracted 6.3mm into the extraction space within 3 weeks.New alveolar bone was generated and remodeled rapidly in the mesial periodontal ligament of the canine during and after distraction. It became indistinguishable from the native alveolar bone 3 months after distraction. During distraction, 73% of the first molar did not move mesially and 27% of them moved mesially less than 0.5mm within 3 weeks. No periodontal defect or endodontic lesion was observed throughout and after distraction. The radiographic examination revealed that apical and lateral surface root resorption of the canine was minimal. They concluded that the periodontal ligament could be distracted to elicit rapid canine retraction without complications.

Jason B.Cope, Richard P.Harper, Mikhail L.Samchukov (1999)[20] evaluated tooth movement through regenerated bone at an early time point during the consolidation phase after bilateral mandibular osteo-distraction. Two beagle dogs underwent 10mm of bilateral mandibular lengthening via intraoral distraction osteogenesis between the fourth premolars and first molars. After 1 week of consolidation retraction of the fourth premolars was initiated, immediately after completing premolar retraction, the dogs were sacrificed and the mandibles were analyzed radiographically, histologically, and by dental cast measurements. Initially, all 4 fourth premolars moved distally with 2 of the 4 touching the first molars at the time of sacrifice. They concluded that it is possible to move teeth through regenerated bone, and it appears that tooth movement can begin within weeks of starting the consolidation period.

Reha S. Kisnisci, Stephen D. Fowel, Bruce N. Epker(1999)[37] reported the first case of distraction osteogenesis to widen the mandible with the use of a tooth-borne appliance. In this report, a patient with Silver Russell syndrome and severe mandibular hypoplasia was treated by means of distraction osteogenesis of the midsymphysis to widen the mandible in concert with sagittal-ramus osteotomies to lengthen the mandible, so that severe crowding could be treated with non-extraction orthodontics. The authors concluded that this treatment created significantly increased arch length in the mandible, which was necessary to facilitate the patient's orthodontic treatment and this approach appears to have merits for consideration in similar patients with deficient lower jaws and moderate to severe arch-length discrepancies.

Liou EJW, Alvaro A. Figueroa and John W.Polley (2000)[27] hypothesized that a tooth can be moved into the fibrous new bone created by the distraction process at a rapid rate. Four mature beagle dogs were used and an edentulous space was created in 2 weeks by using a bone-borne intraoral distraction device on each side of the mandibular body between the third and fourth premolars. Calibrated elastic threads with 50 g of orthodontic force were applied to move the fourth premolar into the edentulous space for 5 weeks. On one side, the tooth was moved simultaneously with distraction; and on the opposite side, it was initiated immediately after the cessation of distraction. The fourth premolars were moved 1.2 mm per week. With this approach, most of the periodontal support was preserved after orthodontic tooth movement. In contrast, moderate to severe alveolar bone loss was noted in the fourth premolars moved simultaneously with distraction. The authors concluded that clinical implication of these results can be applied to relieve severe dental crowding and to correct sagittal or transverse dental arch discrepancies.

Hoggan B.R, Sadowsky C (2001)[16] evaluated the use of palatal rugae as reference points for the measurement of tooth movement, in a manner comparable with cephalometric superimpositions. The sample consisted of pretreatment and posttreatment maxillary study models and lateral cephalometric radiographs from 33 patients who had received orthodontic treatment that involved the extraction of the maxillary first permanent premolars. The mean age at the start of treatment was 13 years 11 months, and the average time between records was 35 months. The anteroposterior movement of the maxillary first molars and central incisors was evaluated with the use of 2 cephalometric variables and 12 study model variables that were reduced to 6 by the combining of the left and right sides. No statistical differences were found between the mean molar movement that was measured cephalometrically and the mean molar movement that was relative to the medial and lateral ends of the first and second palatal rugae or relative to the medial end of the third palatal ruga. Also, no statistical differences were found between the mean incisor movement that was measured cephalometrically and the mean incisor movement that was relative to the medial and lateral end of the third palatal ruga. These findings suggest that ruga landmarks can be used as reliably as cephalometric superimpositions to assess anteroposterior molar movements.

Kisnisci RS, Iseri H, Tuz H, Altug A (2002)[25] presented a technique of "rapid orthodontic canine retraction” to reduce the overall orthodontic treatment time by means of dento-alveolar distraction osteogenesis. The dento-alveolar segment is designed as 'bone transport segment" for posterior movement. Eleven patients undergoing orthodontic treatment with bilateral first premolar extractions and subsequent bilateral canine tooth distalization underwent osteotomy around the canine. The first premolar was extracted, and the buccal bone was carefully removed. After wound closure, a special orthopedic device was mounted and cemented to the first molar and canine teeth. Distraction was started the same day at the rate of 0.4mm twice a day and continued until canine tooth moved posteriorly and made contact with the second premolar in 8 to 12 days. The distraction rate and the device were well tolerated by all patients. The device was then removed and orthodontic therapy was continued with fixed appliances. Result suggests there was no anchorage loss in the second premolar and first molar teeth. Root resportion, dental ankylosis were not detected, no discoloration or loss of tooth vitality was noted. They concluded that the concept of distraction osteogenesis for rapid orthodontic tooth movement is promising and feasible.

Norimichi Nakamoto, Hiroshi Nagasaka,Takayoshi Daimaruya,Ichiro Takahashi,Junji Sugawara,Hideo Mitani (2002)[32] verified the influence of tooth movement on tooth roots and periodontal tissues when teeth were moved into mature, well organized, and mineralized bone created after distraction osteogenesis compared with immature, fibrous, and less-mineralized bone. Six 15-month-old male beagle dogs underwent 10mm of bilateral mandibular distraction osteogenesis. After 2-week (group 1) and 12-week (group 2) consolidation, third premolars were moved into the regenerated bone with l00grams of orthodontic force for 12 weeks. Simultaneously, second premolars were also moved distally as controls. Result showed that in group 1 considerable root resorption extending into the dentin and the thickness of the dentin became approximately half that of the compression side. In group 2, root resorption on the compression side reached the dentin, but the root resorption was less than in group 1. The authors concluded that heavy and early orthodontic tooth movements are not recommended

Dolanmaz and Ali Ihya et al (2003)[10] This article evaluates the usage of distraction osteogenesis (DO) in the treatment of cleft alveoli. The procedure was carried out on eight alveolar clefts of five patients between the ages of 17 and 25 years. Three patients had bilateral alveolar clefts (BAC) and two patients had unilateral alveolar clefts (UAC). DO was carried out bilateral to the palatal segments for the BAC patients and unilateral to the lesser segment for the UAC patients. A custom-made tooth-borne distractor was used. The average amount of distraction was eight mm (range, 5–11.5 mm). The average amount of distal movement of the anchorage teeth was 0.8 mm (range, 0–2 mm). The average amount of inclination changes of the transport segments and anchorage teeth was 7.68 (range, 2–17.58) and 3.38 (range, 0–98), respectively. Two important problems were observed attributable to the method. First, the transport segment was docked in a more superior

position at the end of distraction process. This undesirable movement also changed the inclination of the teeth in the transport segment and increased tooth tipping. Removing the device in the second week of the consolidation period and retracting the segment to its ideal position orthodontically solved these problems.

Second, the bony defect on the nasal side of the alveolar cleft could not be completely closed. This method for repairing small or large alveolar clefts is a simple, cost-effective, and useful treatment option. However, repairing the alveolar cleft without grafts seems to be impossible when using a tooth-borne device

C.W.Hughes, R.W. Williams, M.Bradley, and G.H.Irvine (2003)[4] Ultrasound scanning is non-invasive, widely available, avoids exposure to ionising radiation and is in-expansive. Monitoring of callus distraction is possible with clinical observation, plain radiography, dual-energy X-ray absorptiometry (DEXA), computed tomography(CT) and ultrasound scanning. Plain radiography, although it enables accurate measurement of the distraction gap, does not give sufficient detail to allow assessment of the early stages of osteogenesis and gives no indication of the soft tissue morphology surrounding the gap. The development of callus also appears later on the plain radiographs compared with DEXA and ultrasound. DEXA scanning does not give accurate details about bone density, but as with plain radiography and CT involves cumulative exposure to ionising radiation. Ultrasound scanning enables continuous monitoring of callus gap with no exposure to ionising radiation and allow detection of fine detail, which may influence manipulation of the callus.

Seher Sayin, Osman Bengi, Umit gurton, Kerim Ortakoglu (2004)[40] evaluated the effects of rapid canine distalization through the distraction of periodontal ligament on the dentoalveolar tissues using semi-rigid, individual tooth-borne distractors. The study was carried out on 43 canine teeth in 18 patients who required first premolar extractions. The second premolar and first molar were used as anchor units. The distractor was activated 0.25mm three times a day, and the canines were distalized efficiently on average of three weeks. They concluded that the maxillary canines were distalized in an average of 5.76mm with 11.47° distal tipping. The maxillary first molar moved mesially 0.56mm and extruded 0.64mm. The maxillary incisors showed 1.44° of palatal tipping. The mean distal movement of the mandibular canines was 3.5mm with 7.16^{c} distal tipping. Anchorage loss was not observed in the mandibular first molars.

Haluk Iseri, Reha Kisnisci, Nurettin Bzizi, and Hakan Tüz (2005)[18] to shorten treatment time, a new technique of rapid canine retraction through distraction osteogenesis was introduced to see the effects of dentoalveolar distraction on the dentofacial structures. The study sample consisted of 20 maxillary canines in 10 growing or adult subjects (mean age, 16.53 years; range, 13.08-25.67 years). First premolars were extracted, the dentoalveolar distraction surgical procedure performed, and a custom-made intraoral, rigid, tooth-borne distraction device was placed. The canines were moved rapidly into the extraction sites in 8 to 14 days, at a rate of 0.8 mm per day. Full retraction of the canines was achieved in a mean time of 10.05 (+/-2.01) days. The anchorage teeth were able to withstand the retraction forces with minimal anchorage loss. The mean change in canine inclination was 13.15 degrees +/- 4.65 degrees, anterior face height and mandibular plane angle increased and overjet decreased significantly at the end of dentoalveolar distraction. They concluded that the dentoalveolar distraction technique is an innovative method that reduces overall orthodontic treatment time by nearly 50% with no unfavorable effects on surrounding structures.

John E. Bilodeau(2005)[21] treated a woman with a Class III malocclusion who was a poor candidate for orthognathic surgery. An orthodontic treatment plan was developed that incorporated a relatively new and rapid process of canine distraction. The mandibular first premolars were extracted, correcting the anterior crossbite, the Class III canine relationship, and the Class III facial appearance. The canines were distracted, through the periodontal ligament, into the extraction sites. He concluded that dental distraction is a breakthrough for orthodontics, especially for adults with critical anchorage requirements.

Osman Bengi, Seniz Karacay, Erol Akin, Huseyin Olmez, K.Murat Oku And Sila Mermut(2005)[33] Rapid canine distalization is a technique involving periodontal ligament distraction. The primary aim of this technique is to distalize the canines without anchorage loss and to shorten the duration of orthodontic treatment. After the rapid canine distalization, the healing process of the periodontal ligament is similar to rapid palatal expansion and requires a consolidation period. The long consolidation period of the technique conflicts with the second aim. Skeletal anchorage systems seem to compensate for this conflict because they can be also used for retraction of incisors during consolidation period. This case report presents the orthodontic treatment of a 16-year-old female, who had a bimaxillary retrusion and a dental Class II division I malocclusion. Upper first premolars were extracted and, while the canines were being distalized rapidly by periodontal ligament distraction, the incisors were retracted using a zygomatic anchorage system. The treatment of the patient was completed in five months without any anchorage loss.

Yusuf Sukurica; Ali Karaman; Hakan Gurcan Gurel; Dogan Dolanmaz(2007)[49] conducted a study to achieve rapid canine distalization by segmental alveolar distraction method in first premolar extraction cases, to examine the changes in the periodontal tissues surrounding canines, to evaluate the displacement of the canine and first molar teeth, to assess the effects of the procedure on the pulpal vitality of the canines, and to determine the amount of root resorption in retracted canines. The sample of the study consisted of 20 teeth in eight patients (four females and four males, mean age 18.5 years).. The distraction procedure was completed in 12 to 28 days (mean 14.65 ± 3.49).There was a statistically significant difference in the axial inclinations of the distracted canines, whereas there was no statistically significant difference in the axial inclinations of the first molars after the completion of distraction. The results obtained from the periodontal indices showed that there was no statistically significant difference among the results of periodontal indices.It was observed that all the teeth in the study sample were vital before the distraction, and none of the teeth reacted positively to the vitality test after the distraction procedure. It was observed that the amount of root resorption that occurred during distraction was insignificant. The anchorage loss ranged from 0 to 3 mm (mean 1.2 ± 0.83). The distal displacement of the canines ranged from 3 to 8 mm (mean 5.35 ± 1.22). The canines showed a mean of 9.1° distal tipping, whereas there was no statistically significant change in the axial inclinations of first molars after distraction. They concluded that rapid canine distalization by segmental distraction osteogenesis will become a routine protocol and a popular method among orthodontic applications.

Tao Lv, Na Kang, Chunling Wang, Xianglong Han, Yangxi Chen, and Ding Baif (2009)[44] conducted a study, to evaluate the security and feasibility of rapid tooth movement with periodontal ligament distraction. Eight male beagles, aged 13 to 16 months, were used in this study. Extraction of the mandibular second premolar and alveolar surgery to reduce the osteal resistance on the mesial side of the extraction socket were performed on the experimental side. Then a device was placed to distract the first premolars distally on the experimental side; on the control side, the first premolars were distalized with nickel-titanium coil springs. The beagles were killed in the first, second, fourth, and eighth weeks after orthodontic force application. The first premolar on the experimental side moved more rapidly than that on the control side ($P < 0.05$). Histological data indicated that more new bone was deposited on tension area of the experimental side than on the control side. Active and extensive bone resorption in the compressive area and bone deposition in the tension area were observed on the experimental side. They concluded that the periodontal ligament can be rapidly distracted without complications.

The rapid orthodontic tooth movement by distracting the periodontal ligament cannot be emulated by current conventional orthodontic concepts and method.

Gokmen Kurt; Haluk Iseri; Reha Kisnisci (2010)[13] carried out DAD technique in a 15-year-old skeletal and dental Class II female patient with an overjet of 9 mm. A custom-made, rigid, tooth-borne intraoral distraction device was used for rapid canine retraction. Osteotomies surrounding the canines were made to achieve rapid movement of the canines within the dentoalveolar segment, in compliance with distraction osteogenesis principles. The amount of canine retraction was 7.5 mm in 12 days at a rate of 0.625 mm per day, with no posterior anchorage loss. The canine teeth showed 1.6 mm extrusion and 11 degrees inclination change (distal tipping) during the same period. Orthodontic treatment continued for 6 months with no clinical and radiographic evidence of complications such as root fracture, root resorption, ankylosis, and soft tissue dehiscence. They concluded DAD technique is an innovative method, because it reduces overall orthodontic treatment time by about 50%, with no unfavorable effects on periodontal tissues and surrounding structures and with no need to use any intraoral or extraoral anchorage appliances.

V.R. Kharkar, S.M.Kotrashatti, P.Kulkarni (2010)[45] the purpose of study was to compare two recent surgical method of rapid canine retraction to reduce treatment time. Six patients, comprising two groups, were compared using two different surgical techniques: dentoalveolar distraction and periodontal distraction using indigenously designed intra-oral distractor. The aim was to assess and evaluate the best approach to reduce osteogenesis. The patients were assessed at the regular interval with I.O.P.A and lateral cephalograms for gauging the time required for retraction, canine tipping, anchorage loss and external root resorption. Deantoalveolar distraction was superior to periodontal distraction in all area of assessment.

Adam C. Spencer, Phillip M. Campbell, Paul Dechow, Michael L. Ellis, and Peter H. Buschange (2011)[1] conducted a experimental study to evaluate how the rate of dentoalveolar distraction into a bony defect affects bone quality and quantity. 6 adult foxhound dogs were used and a randomized splitmouth design,evaluated the differences between regenerate bone produced by distracting segments of bone containing the second premolars at either 1 or 2 mm per day for 5 days, followed by a 6-week consolidation period. Microcomputed tomography was used to evaluate bone density, percent bone volume trabecular number, trabecular separation, and trabecular thickness. The lingual aspect of the regenerate exhibited more bone than did the buccal aspect, and all but one of the 12 specimens showed less than 1 mm of vertical bone deficiency in the regenerate area. No differences were found between the 1-mm per day and the 2-mm per day rates for bone density, percent bone volume, trabecular number, trabecular separation, and trabecular thickness. Compared with control bone, the regenerate bone was less dense, and had less bone volume,a higher trabecular number, and approximately half the trabecular thickness. Bone regenerate produced by rates of 1 and 2mmper day of dentoalveolar distraction was similar in quality and quantity. Although less mature, the size and shape of the regenerate bone produced by rapid dentoalveolar distraction was comparable with the control bone.

Chufeng Liu, Yang Cao, Conghua Liu, Jincai Zhang, Pingping Xu(2011)[7] study sought to establish an animal model to study the feasibility and safety of rapid retraction of maxillary anterior teeth en masse aided by alveolar surgery in order to reduce orthodontic treatment time. Extraction of the maxillary canine and alveolar surgery were performed on twelve adult beagle dogs. After that, the custom-made tooth-borne distraction devices were placed on beagles' teeth. Nine of the dogs were applied compression at 0.5 mm/d for 12 days continuously. The other three received no force as the control group. The animals were killed in 1, 14, and 28 days after the end of the application of compression.The tissue responses were assessed by craniometric measurement as well as histological examination. Gross alterations were evident in the experimental group, characterized by anterior teeth crossbite. The average total movements of incisors within 12 days were 4.6360.10 mm and the average anchorage losses were 1.2560.12 mm. Considerable root resorption extending into the dentine could be observed 1 and 14 days after the compression. But after consolidation of 28 days, there were regenerated cementum on the dentine. There was no apparent change in the control group. No obvious tooth loosening, gingival necrosis, pulp degeneration, or other adverse complications appeared in any of the dogs. This was the first experimental study for testing the technique of rapid anterior teeth retraction en masse aided by modified alveolar surgery. Despite a preliminary animal model study, the current findings pave the way for the potential clinical application that can accelerate orthodontic tooth movement without many adverse complications.

Pankaj J. Akhare, Akshay M. Daga, Shilpa Pharande(2011)[34] study consisted of 20 maxillary canines in 10 growing or adult subjects. First premolars were extracted, the dentoalveolar distraction surgical procedure performed, and a custom-made intraoral, rigid, tooth-borne distraction device was placed. The canines were moved rapidly into the extraction sites in 8 to 14 days, at a rate of 0.8 mm per day. Full retraction of the canines was achieved in a mean time of 10.05 (–2.01) days. The anchorage teeth were able to withstand the retraction forces with minimal anchorage loss. The mean change in canine inclination was 13.15° – 4.65°, anterior face height and mandibular plane angle increased. No clinical and radiographic evidence of complications, such as root fracture, root resorption, ankylosis, periodontal problems, and soft tissue dehiscence, was observed. Patients had minimal to moderate discomfort after the surgery.

Paulo Renato Carvalho Ribeiro, Sérgio Henrique Casarim Fernandes, Gustavo Saggioro Oliveira (2011)[35] propose changes in the original surgical technique of periodontal and in the placement of distractors from buccal access to palatal distractor. After premolar extraction, before starting to deepen the alveolus, a 1.5 cm crescent-shaped incision is made in the alveolar mucosa above the root of the first premolar. By removing the periosteum the buccal bone plate is exposed. Normally, one finds an extremely thin cortex with some fenestrations already present at the extraction site, which facilitates the opening of a bone chamber. By increasing this opening in the apical direction, one can also accomplish through it, under direct vision, a horizontal corticotomy above the apex of the canine without risks. This modification imparts increased speed and security to the surgery, although it does not completely eliminate the need for transoperative radiographs to verify that the alveolus is properly deepened above the apex of the canine. Such radiographs are essential to ensure freedom from bone interference in the apical third. Should this not occur, regardless of the technique, the canine will not undergo bodily movement and wil simply incline distally , which will cause the procedure to fail. In order to avoid proclination of the maxillarymcanines during rapid canine retraction in cases where canines are well positioned in the buccopalatal direction, or else to move them into the alveolar process in cases where they are initially proclined, somechanges were proposed in the manner in which distractors are fabricated and placed as a measure to prevent buccal inclination of the canines and thus preserve the thin buccal bone plate. Palatal distractors has the advantage of being easy to fabricate while eliminating the need for trimmings and adjustments, since these devices are nothing but Hyrax screws used in the sagittal direction. However, the cementation process is delicate because of differences between the positions of the canines and molars (mesial and buccal axial inclinations of canines) and if any interference occursin canine movement linked to difficulties in the surgical procedure of deepening the tooth socket, simultaneous movement of the right and left canines will be impaired. The unilateral palatal distractor has proved to be a good choice as it allows good control in the transverse plane while maintaining each side independent from each other.

Shadw Mohammed Badr El-Din Aboul-Ela, Amr Ragab El-Beialy et al (2011)[41] The purpose of this study was to clinically evaluate miniscrew implant-supported maxillary canine retraction with corticotomy-facilitated orthodontics. The sample consisted of 13 adult patients (5 men, 8 women; mean age, 19 years) exhibiting Class II Division 1 malocclusion with increased overjet requiring the therapeutic extraction of the maxillary first premolars, with subsequent retraction of the maxillary canines. Corticotomy-facilitated orthodontics was randomly assigned to 1 side of the maxillary arch at the caninepremolar region, and the other side served as the control. By using miniscrews as anchorage, canine retraction was initiated via closed nickel-titanium coil springs applying 150 g of force per side. The following variables were examined over a 4-month follow-up period: rate of tooth movement, molar anchorage loss, plaque index, gingival index, probing depth, attachment loss, and gingival recession. The average daily rate of canine retraction was significantly higher on the corticotomy than the control side by 2 times during the first 2 months after the corticotomy surgery. This rate of tooth movement declined to only 1.6 times higher in the third month and 1.06 times higher by the end of the fourth month. No molar anchorage loss occurred during canine retraction on either the operated or the nonoperated side.

REVIEW OF LITERATURE FOR CBCT

Feldkamp L.A., Davis L.C., Kress J.W. (1984)[55] Deduced convolution back projection formula for direct reconstruction of a three-dimensional density function from a set of two-dimensional projections. The formula is approximate but has useful properties, including errors that are relatively small in many practical instances and a form that leads to convenient computation. It reduces to the standard fan-beam formula in the plane that is perpendicular to the axis of rotation and contains the point source. The algorithm is applied to a mathematical phantom as an example of its performance

International Commission on Radiological Protection (ICRP), (1991)[58] Issued a completely new set of recommendations on radiological protection, In publishing these recommendations, the Commission has had three aims in mind: to take account of new biological information and of trends in the setting of safety standards; to improve the presentation of the recommendations; and to maintain as much stability in the recommendations as is consistent with the new information. Its text contains all the recommendations, together with sufficient explanatory material to make clear the underlying reasoning for policy makers.

M. Okan Akcam, Tunc Altiok and Erhan Ozdiler (2003)[50] Described a study to investigate the possibility of enhancing the clinical versatility of the panoramic radiograph, which is an indispensable tool for dental diagnosis. It was concluded that even though panoramic radiographs provide information on the vertical dimensions of craniofacial structures, clinicians should be vigilant when predicting skeletal cephalometric parameters from panoramic radiographs, clinicians should be vigilant when predicting skeletal cephalometric parameters from panoramic radiographs, because of their lower predictability percentages.

Ludlow J.B., Davies-Ludlow L.E., Brooks S.L. (2003)[61] Published a study that provides comparative measurements of effective dose for three commercially available, large (12") field-of-view (FOV), CBCT units: CB Mercuray, NewTom 3G and i-CAT. From the conducted study it was conclude that CBCT dose varied substantially depending on the device, FOV and selected technique factors. Effective dose detriment is several too many times higher than conventional panoramic imaging and several times less than reported doses for conventional CT.

Sunny Young Hutchinson (2005)[66] published an article to compare the accuracy of angular measurements of the panoramic image of the NewTom 9000 cone beam computed tomography (CBCT) with the Sirona Orthophos panoramic unit . The dimensional measurements of the NewTom 9000 were statistically similar to the model measurements. It was therefore concluded that the New-Tom 9000 dimensions, including angular dimensions, are much more accurate than those of Sirona angular dimensions.

Van Der Stelt P.F.(2005)[67] described the different technologies used for digital radiography in dentistry. It also includes a broad overview of the benefits and limitations of digital radiography to help us understand the role, technology can play in our practices. Digital radiography no longer is an experimental modality. It is a reliable and versatile technology that expands the diagnostic and image-sharing possibilities of radiography in dentistry. Optimization of brightness and contrast, task-specific image processing and sensor-independent archiving are important advantages that digital radiography has over conventional film-based imaging.

Leah Walker, Reyes Enciso and James Mahc (2005)[68] Performed a study was to describe the spatial relationship of impacted canines by using images obtained with the NewTom QR-DVT 9000 (QR Srl, Verona, Italy). From the performed study it was conclude that 3D volumetric imaging of impacted canines can show the following: presence or absence of the canine, size of the follicle, inclination of the long axis of the tooth, relative buccal and palatal positions, amount of the bone covering the tooth, 3D proximity and resorption of roots of adjacent teeth, condition of adjacent teeth, local anatomic considerations, and overall stage of dental development. In short, 3D imaging is clearly advantageous in the management of impacted canines.

Stuart C. White, Michael J. Pharoa (2008)[65] published an introductory article that provides an overview of the imaging principles underlying each of the technologies such as periapical radiography, extra oral radiography, CT, CBCT, MRI, nuclear medicine, identifies dental applications, and, in particular, focuses on the emerging role of cone-beam imaging in dentistry. Some areas of CBCT that need further attention are also considered. Conventional tomography has been substantially replaced by CBCT and is not considered.

William C. Scarfe, and Allan G. Farman (2008)[69] introduced an article is to provide an overview of CBCT technology and an understanding of the influence of technical parameters on image quality and resultant patient radiation exposure The introduction of cone-beam computed tomography (CBCT) specifically dedicated to imaging the maxillofacial region heralds a true paradigm shift from a 2D to a 3D approach to data acquisition and image reconstruction. It also explains the expanding the role of imaging from diagnosis to image guidance of operative and surgical procedures by way of third-party applications software.

Allan G. Farman and William C. Scarfe (2009)[51] Published an article describing the development of compact, relatively low cost, high quality, large, flat-panel detector arrays; the availability of low cost computers with processing power sufficient for cone-beam image reconstruction; the fabrication of highly efficient x-ray tubes capable of multiple exposures necessary for cone beam scanning at prices lower than those currently used for fan-beam computerized tomography; and limited volume scanning (e.g., head and neck) eliminating the need for sub second gantry rotation speeds. CBCT provides three-dimensional images that facilitate the transition of orthodontic imaging from initial diagnosis to image guidance throughout the treatment phase.

Gyu-Tae Kim, Seong-Hun Kim,Yong-Suk Choi et al (2009)[56] The purposes of this study were to evaluate the actual post placement positions of orthodontic miniplate anchoring screws (MPAS) and to determine the risk factors for their failure and iatrogenic effects on the intraoral structures. Three-dimensional cone-beam computed tomography images were generated to examine 31 orthodontic miniplates and their MPAS (diameter, 1.5 mm; length, 4 mm), which showed good clinical stability 6 months after placement in the posterior maxilla of 18 patients. The mean placement depth of the MPAS was 2.48mm with no significant difference relative to their position. Twenty-six (of 74) MPAS were placed in the dentition area. Of these 26, 14 were placed in interdental spaces, and the other 12 followed the direction of the roots. Nine MPAS showed root proximity, and 7 MPAS had root penetration, all of which were placed in the central position of the miniplate. Thirty-nine MPAS penetrated the sinus, indicating a low interrelationship between placement depth and cortical bone thickness of the sinus. Miniplates were successfully retained by MPAS even with less-than-ideal placement. Root contact and proximity of MPAS seem to have minimal effects on the successful stabilization of miniplates. Pertinent guidelines should, however, be followed during MPAS placement to minimize the risk of damage to adjacent roots.

H Selim, N Elbargothy, Y Nabil and I El-Hakim(2009)[57] The aim of this study is to find a more conservative protocol for the evaluation of callus distraction by monitoring bone healing using two different examination tools: ultrasonography and dental CT. Four adult patients (three women and one man) underwent mandibular distraction (using two intraoral and two extraoral devices). The latency period was 5–7 days and the distraction was at a rate of 2 mm per day, with 12–14 weeks of consolidation. All patients were evaluated during activation, 3 months, 6 months and 1 year post-distraction. Evaluation included clinical examination, plain radiographs, CT and ultrasonography examinations. Ultrasonographic examination of the healing callus revealed four different phases of maturation. These phases were similar to the degree of tissue calcification as measured by CT. Tissue density across the distraction wound at the time of distractor removal (12– 14 weeks) was equal to or less than one-third of normal bone density.

Stephen A. Schendel and Chris Lane (2009)[64] published an article explaining image fusion which involves combining images from different imaging modalities to create a virtual record of an individual called a patient-specific anatomical reconstruction (PSAR). This can then be used to perform virtual surgery and establish a definitive and objective treatment plan for correction of the facial deformity. The end result is improved patient care and decreased expense. This is particularly important when the deformities are complex involving both function and esthetics such as those in the dentofacial area and with orthognathic surgery.

Sharon L. Brooks (2009)[63] published an article that reviews the general principles of radiation biology and dose measurement. Effective doses for typical imaging examinations used in orthodontics include: panoramic, 5.5 to 22 microsieverts (Sμv); cephalometric, 2.4 to 6.2 μSv; large field-of-view cone beam CT, 58.9 to 1025.4 μSv. This can be compared with average annual natural background radiation of 3000 μSv/yr. Issues of radiation risk, particularly for children, as well as mechanisms for dose reduction are also discussed.

CARMEN ELENA GEORGESCU,A. MIHAI et al (2010)[52] Conducted a study to quantitatively and qualitatively evaluate anterior mandibular area on CBCT comparing to orthopantomography (OPG). Fifty-one dental patients, aged between 20 and 77 years, were quantitatively analyzed and 81 dental patients, aged between 20 and 79 years, were qualitatively analyzed. ANOVA and Mann–Whitney tests were used for statistical analyses. Strong statistical significant differences were recorded between CBCT and OPG assessments for all groups of teeth (p<0.001), when evaluation was performed on distances to mandibular base. When assessing the distance to the incisive canal, the differences were recorded only for the left canine zone. Mean densities of central incisor, lateral incisor and canine regions, were1,400–1,425 HU, 1,212–1,224 HU, and 1,150–1,175 HU, respectively. There was a marginal statistical evidence that bone density was lower in canine zone comparing to central incisor area (p=0.08). Measurements on CBCT are more accurate when compared with OPG. Bone density of central incisor region is higher. Therefore, CBCT permits the clinician to have all necessary information when planning dental implants.

Marlon Sampaio Borges, José Nelson Mucha (2010)[62] Conducted a study to assess maxillary and mandibular alveolar and basal bone density in Hounsfield units (HU). Eleven files with CT images of adults were used to obtain 660 measurements of bone density: alveolar (buccal and lingual cortical) bone, cancellous bone and basal bone .(maxilla and mandible). The Mimics software 10.0 (Materialize, Belgium) was used to estimate values. In the maxilla, the density of buccal cortical bone in the alveolar region ranged from 438 to 948 HU, and the lingual, from 680 to 950 HU; cancellous bone ranged from 207 to 488 HU. The buccal basal bone ranged from 672 to 1380 HU, and cancellous bone, from 186 to 402 HU. In the mandible, the buccal cortical bone ranged from 782 to 1610 HU, the lingual cortical alveolar bone, from 610 to 1301 HU, and the cancellous bone, from 224 to 538 HU. In the basal area, density was 1145 to 1363 HU in the buccal cortical bone and 184 to 485 HU in the cancellous bone. In the maxilla, the greatest bone density was found between the premolars in the buccal cortical bone of the alveolar region. The maxillary tuberosity was the region with the lowest bone density. Bone density in the mandible was higher than in the maxilla, and there was a progressive increase from anterior to posterior and from alveolar to basal bone.

James K. Mah, Liu Yi, Reyes C. Huang, and HyeRan Choo (2011)[60] Published an article that describes the advanced cone beam computed tomography (CBCT) applications in orthodontic diagnosis and treatment planning. The limitations of conventional 2-dimensional planar film are discussed, and case examples are described that highlight the additional diagnostic information and many benefits derived from 3-dimensional imaging. It also includes how CBCT software can manipulate the Digital Imaging and Communications in Medicine (i.e., DICOM) data to visualize anatomic structures and accurately display relationships within the craniofacial complex. A combination of volumetric reconstruction and multiplanar views can provide the orthodontic clinician with skeletal hard tissue, soft tissue, dentition, and airway information. He further stated that Nonstandard orthodontic cases, such as impacted teeth, supernumerary odontomas, or unexpected radiologic observations, such as pathologic lesions or incidental findings are best visualized with the 3-dimensinoal CBCT scan, advanced CBCT software applications also can be used to quantify airway space (relevant for sleep apnea cases), perform superimpositions of objects at different time points to semi quantitatively visualize changes (e.g., mandibular growth, temporomandibular joint, airway), and generate digital dental models to streamline the workflow in the orthodontic clinic.

Lucia H. C. Cevidanes, Ana Emilia Figueiredo Oliveira et al (2011)[53] published a paper that outlines the clinical application of cone beam computed tomography (CBCT) for the assessment of treatment outcomes and discusses current work to superimpose digital dental models and 3-dimensinal photographs. Superimposition of CBCTs on stable structures of reference now allow assessment of 3-dimensional.

Elias Kontogiorgos, Mohammed E. Elsalanty et al (2012)[54] The purpose of this study was to evaluate the structure and material properties of native mandibular bone and those of early regenerate bone, produced by bone transport distraction osteogenesis. Ten adult foxhounds were divided into two groups of five animals each. In all animals, a 3- to 4-cm defect was created on one side of the mandible. A bone transport reconstruction plate, consisting of a reconstruction plate with an attached intraoral transport unit, was utilized to stabilize the mandible and regenerate bone at a rate of 1 mm/day. After the distraction period was finished, the animals were killed at 6 and 12 weeks of consolidation. Microcomputed tomography was used to assess the morphometric and structural indices of regenerate bone and matching bone from the unoperated contralateral side. Significant new bone was formed within the defect in the 6- and 12-week groups. Significant differences ($P \leq 0.05$) between mandibular regenerated and native bone were found in regard to bone volume fraction, mineral density, bone surface ratio, trabecular thickness, trabecular separation, and connectivity density, which increased from 12 to 18 weeks of consolidation. We showed that regenerated bone is still mineralizing and that native bone appears denser because of a thick outer layer of cortical bone that is not yet formed in the regenerate. However, the regenerate showed a significantly higher number of thicker trabeculae.

Jae-Jung Yu; Gyu-Tae Kim; Yong-Suk Choi et al (2012)[59] validated the accuracy of a cone-beam computed tomography (CBCT)–guided surgical stent for orthodontic mini-implant (OMI) placement by quantitatively evaluating the difference between CBCT-prescribed and actual position of mini-implants in preoperative and postoperative CBCT images. A surgical stent was fabricated using Teflon-Perfluoroalkoxy, which has appropriate biological x-ray attenuation properties. Polyvinylsiloxane impression material was used to secure the custom-made surgical stent onto swine mandibles. CBCT scanning was done with the stent in place to virtually plan mini-implants using a three-dimensional (3D) software program. An appropriate insertion point was determined using 3D reconstruction data, and the vertical and horizontal angulations were determined using four prescribed angles. A custom-designed surveyor was used to drill a guide hole within the surgical stent as prescribed on the CBCT images for insertion of 32 OMIs. The mandibles with a surgical stent in place were rescanned with CBCT to measure the deviations between the virtual planning data and surgical results. The difference between the prescribed and actual vertical angle was 1.01 6 7.25, and the horizontal difference was 1.16 6 6.08. The surgical stent in this study guides mini-implants to the prescribed position as planned in CBCT. Since the statistical difference was not significant, the surgical stent can be considered to be an accurate guide tool for mini-implant placement in clinical use.

The sample for the study consisted of twenty maxillary canines in 10 patients (8 female, 2 male) were selected for fixed orthodontic treatment in Department of Orthodontics and Dentofacial Orthopaedics, Tamil Nadu Government Dental College and Hospital, Chennai. The selected patients were between the age group of 13-25 years. According to little irregularity index[36], patients with angle's class I malocclusion with moderate to severe crowding angle were selected.

INCLUSION CRITERIA:

1. Class I patients with moderate to severe crowding or increased overjet.
2. Patients who needed 1st premolar extraction.
3. Normal size and shape of crown and root.
4. Good periodontal condition.
5. Buccally placed or buccally inclined canines.

Exclusion criteria:

1. Skeletal class II or class III
2. Palatally placed canine.
3. Medically compromised patient.
4. Severely uncooperative patient.
5. Open bite /cross bite malocclusion.

6. Dilacerated canine roots.

7. Previous h/o any surgical or nonsurgical orthodontic treatment.

8. Hypo or hyperdivergent cases

DISTRACTION APPLAINCE (fig 1, 2, 3, 4)

Distractor appliance was modified from 13 mm stainless steel hyrax expansion screw (fig 1) by completely opening the screw of the appliance and just rotating it 90 degree (fig 2) without clipping any of the arm of hyrax unlike other study[49], carried out on rapid canine distraction in which one of the hyrax arm was clipped in order to be used as a unilateral appliance[35]. In this study a single Modified hyrax assist in bilateral retraction of canine simultaneously through palatal access. A single palatal rapid canine distraction device was placed on maxillary canines and maxillary 1st molars. Modified hyrax appliance can be divided into 3 parts for better understanding:

1) Anterior section or canine attachment: Soldered to the canine band.

2) Middle section or screw part: A Stainless steel screw which when activated slides the anterior section.

3) Posterior section or molar attachment: Soldered to the molar band

FIG 1 Hyrax expansion screw with key

FIG.2 Rotated hyrax

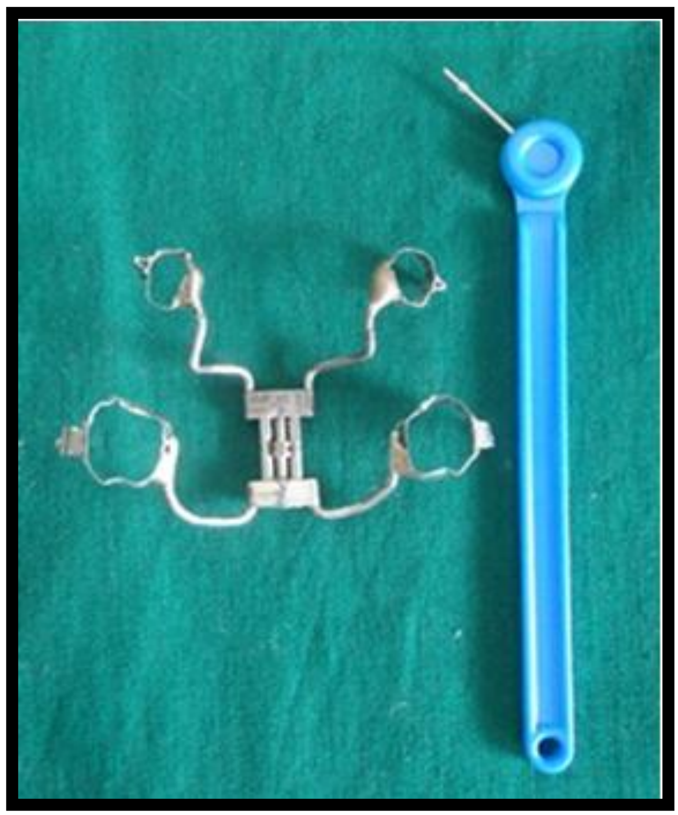


FIG.3 Modified Hyrax distractor with key

FIG.4 Distractor with band cemented after PD surgery

ORTHODONTIC PROCEDURE (fig 4)

Maxillary canines and maxillary molars were banded with rocky mountain orthodontics (RMO) band material. Canine was banded with 0.150 x 0.003(inch) and molar with 0.180 x 0.005(inch) band. Buccal tube was welded on molar and Roth 0.022 inch bracket was welded on canine on both sides. Alginate impression was taken of maxillary arch with bands and it was poured with plaster of Paris. Modified hyrax rotated 90^0 was adapted to the contour of the palate with sufficient space between the palate and the appliance. Appliance should not be too low from the palate such that swallowing and speech are affected. Anterior section was kept parallel to the anticipated path of canine movement and screw was subsequently activated to distract canine along the path of anterior section.

1. Hyrax rapid expansion screw which can open up to 13mm was selected for fabrication of modified hyrax distraction device
2. Modified hyrax having screw and guidance bar was adapted to molar and canine band and soldered on palatal part of the canine and molar bands
3. The pitch of hyrax is 360=0.8mm
4. The weight of modified hyrax distraction device was 2.15 gm.
5. The rotation from left to right produces closing movement.
6. The patient's parent were demonstrated and taught to close the hyrax screw with key. The screw was activated in morning and evening.

Armamentarium for Banding:

1. Mouth mirror
2. Probe
3. Tweezers
4. Band pusher
5. Band pincher

6. Band contouring plier.

7. Band Material (Rocky Mountain Orthodontics)

Canine tooth- 0.150 x 0.003 (inch)

Molar tooth – 0.180 x 0.005 (inch)

8. Spot welder

Armamentarium for Soldering:

1. Hydro flame soldering unit (Mig -O-Mart)

2. Silver Solder and flux.

SURGICAL PROCEDURE: (fig 5, 6, 14, 15, 16)

Surgical technique was performed under local anesthesia as routine outpatient procedure. The first step to be performed was the 1st premolar extraction on both sides. Then the premolar alveoli were deepened with a round bur (HP no.5) until the entire length of the canine is exceeded by about 2 mm in the apical region (fig 14). The root length of canine from alveolar crest was determined in CBCT and marked on gutta-percha as a guide for deepening the socket (fig 16). The interdental septum located distal to the canine was then uncovered till it was thin and fragile. The next step consisted of performing vertical corticotomies (grooves) in the interdental bone septum distal to the canine with a #701 bur. Initially, two vertical grooves were made, one at the buccal edge and one in the palatine bone on the alveolar wall. These corticotomies are then interconnected by a third (horizontal) corticotomy at its base, performed through intra-alveolar access (fig 5). Once the structure of the interdental septum was weakened, the canine movement was falicitated[28].

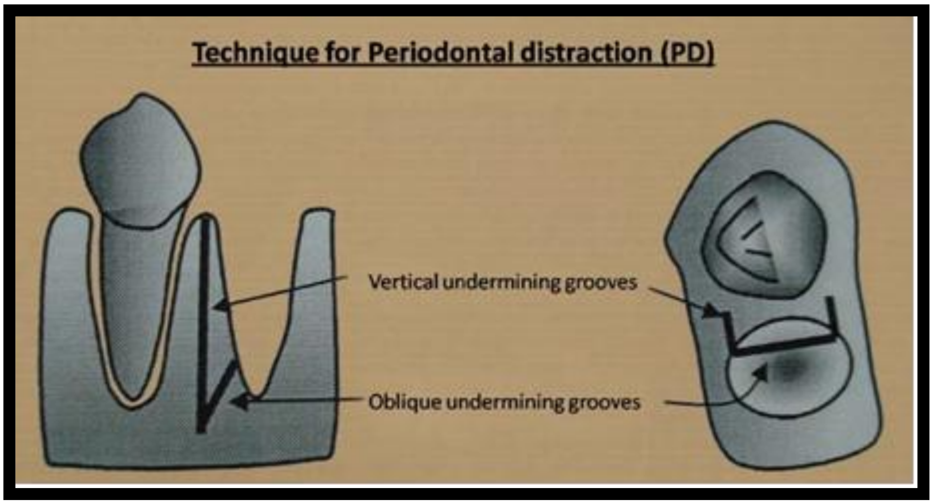


FIG 5 Periodontal distraction surgical technique

Armamentarium for Surgical procedure: (fig 6)

1. Mouth mirror

2. Probe

3. Tweezers

4. Moon's Probe

5. Maxillary premolar extraction Forceps

6. Micro motor straight hand piece with701s.s white bur

7. Suction tip

8. Disposable syringe and needle

9. Local anaesthesia

10. Surgical gloves

11. Kidney tray

12. Mouth mask

13. Towel clips

14. Austin Cheek retractor.

15. Needle holder

16. Artery forceps

17. 3-0 silk suture material

Distraction Protocol:

The sterilized distractor was cemented on the canine and the first molar immediately after the surgery under dry field with glass ionomer luting cement. Distraction was initiated on a third postoperative day. The distractor was activated twice per day, in the morning and evening, for a total of 0.8 mm per day. Immediately after the canine retraction was completed, fixed orthodontic appliance treatment was initiated, and the levelling stage was started in both the dental arches. Ligatures were placed under the arch wire from the distracted canine to the first molar for a period of 3 months after the periodontal distraction procedure.

Materials required for Rate of retraction

The Mesio-distal width of first premolar was measured with digital calliper (Robust, Germany) in a patient mouth and also on Study model by same operator. The distractor was activated at the rate of 0.8mm per day. The distractor was activated till the distal surface of canine contacted the mesial surface of second premolar. The number of days required to close first premolar space were counted, which gave Duration of canine retraction.

Rate of canine retraction = Mesiodistal width of first premolar/ Duration of

Canine retraction

Panoramic radiographic analysis: (fig 7, 9)

The angular changes that occurred during the rapid canine distalization were assessed by examining the panoramic radiographs taken before and after the distraction. All panoramic radiographs were taken with the same orthopantomograph (Planmeca Proline, PM 2002 CC) with each patient's lips in the resting position, the Frankfurt horizontal plane parallel to the floor, and the jaws in centric relation.

Following Reference points and lines used in the panoramic radiographic analysis:

UROr - the most inferior and lateral point of upper right orbit

ULOr- the most inferior and lateral point of upper left orbit

UROr-ULOr- line connecting point UROr to ULOr

To analyze the panoramic radiographs, two reference points were determined and one reference plane was formed by using these points. Additional planes were constructed by connecting the coronal and apical points of root canals of the canines. A total of two angular measurements were made with these points and planes. The axial inclinations of the canines were measured on the panoramic radiographs taken before and after the distraction, and the data obtained were analysed[49]. All reading were taken and measured by the same examiner.

Materials required to measure Anchorage loss of molar (fig 10, 13)

1. Pre-treatment study model
2. Post- distraction study model
3. Transparent grid

Procedure: To evaluate the amount of canine movement and posterior anchorage loss, alginate impressions were taken of all ten patients and poured in hard dental stone. The posterior anchorage loss and the amount of canine movement in the anteroposterior direction were assessed by determining the location of maxillary raphe by using two predetermined reference points. The maxillary (R1) and mandibular (R2) reference planes were formed by plotting tangents to the interdental contact points of the upper and lower central incisors (R1 and R2 were constructed to intersect Rp vertically). The perpendicular distances from the cusp tips of the upper canines and the mesio-buccal cusp tip of the first molars to the reference line were measured. A transparent grid was used to measure the amount of canine and molar movements in the model analysis[49].

Materials required to measure the vitality of canine

1. Electronic pulp tester (API)

2. Electrolyte medium (tooth paste)

Procedure: An electrical vitality test was performed before, after the distraction and after 3 months of distraction with electronic pulp tester (API). The probe of the pulp tester was placed on the occlusal or incisal one-third of the buccal enamel surface of the tooth, and the current was increased gradually. Each patient was observed for signs of pain, and the corresponding number on the scale was registered[49].

BONE DENSITY EVALUATION OF THE DISTRACTED SEGMENT (fig 11, 12)

This study was intended to evaluate the maxillary bone density of the distracted segment i.e. between lateral incisor and canine in the alveolar bone by computed tomography (Cone-Beam), quantitatively in Hounsfield units (HU).

A CBCT device (**Kodak 9500**, fig 8) was used to take a view encompassing the entire maxilla at a resolution of 0.2 mm voxel size both pre-distraction and 3 months after distraction. The technical parameters were the same throughout the study, using 90 kV and 10 mA. The patient’s head was positioned and secured in place so that the occlusal plane was parallel with the positioning beam.

CBCT data was saved in digital imaging and communications in medicine **(DICOM)** format. **CS 3D imaging software** was used to analyze the DICOM data for qualitative measurements.

The densities were measured in Hounsfield units (HU). With help of the software 3D imaging, in sagittal section, CT cuts were made in the alveolar bone height in the range of 3 to 6 mm from the CEJ. Between lateral incisor and canine, the alveolar bone densities for cancellous bone were measured[62].

Presurgically CBCT images were used to accurately evaluate the length of canine and premolar and also helped in assessing the proximity of nasal and sinus floor so as to prevent damage to the important surrounding structures. Mesiodistal thickness between lateral and canine was determined, to assist the surgeon in limiting the depth of vertical corticotomy cut mesiodistally.

Fig 6- Armamentarium for surgical procedure

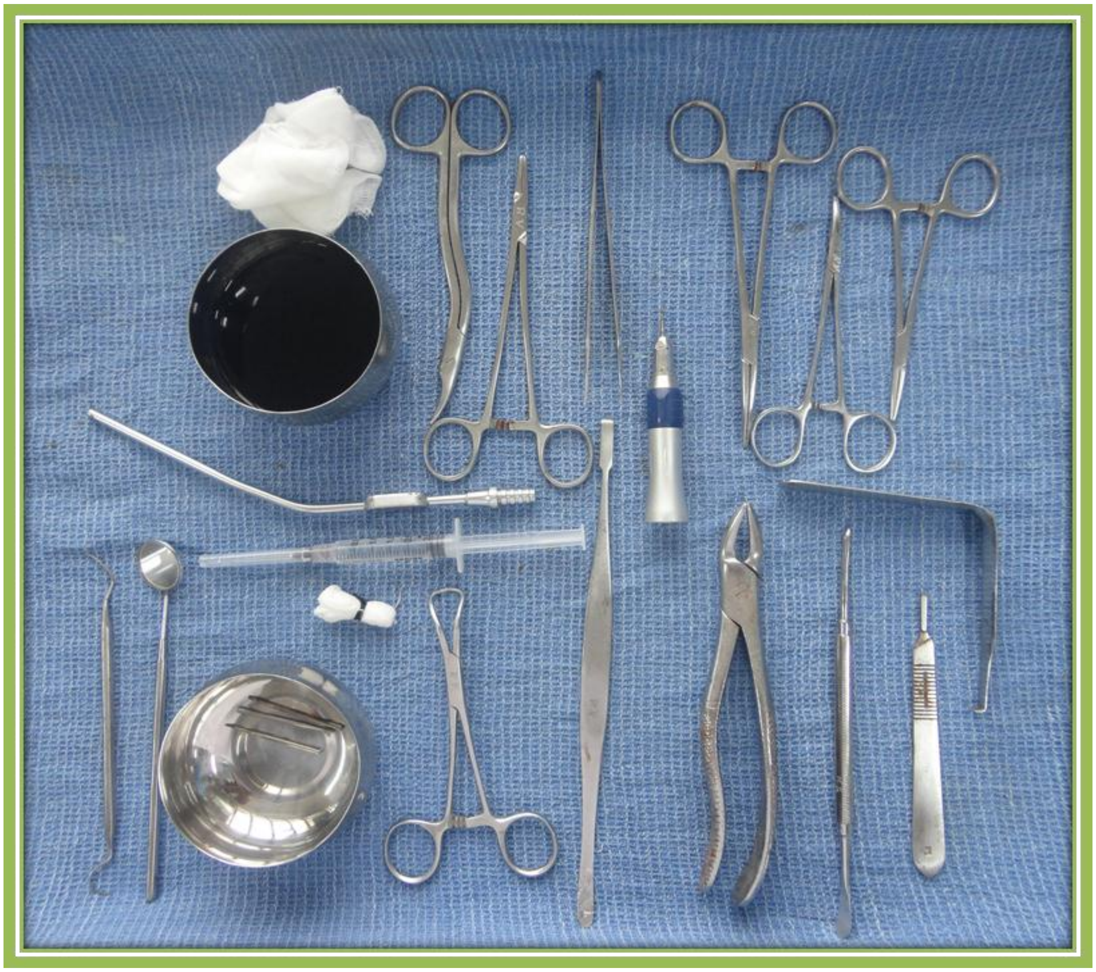
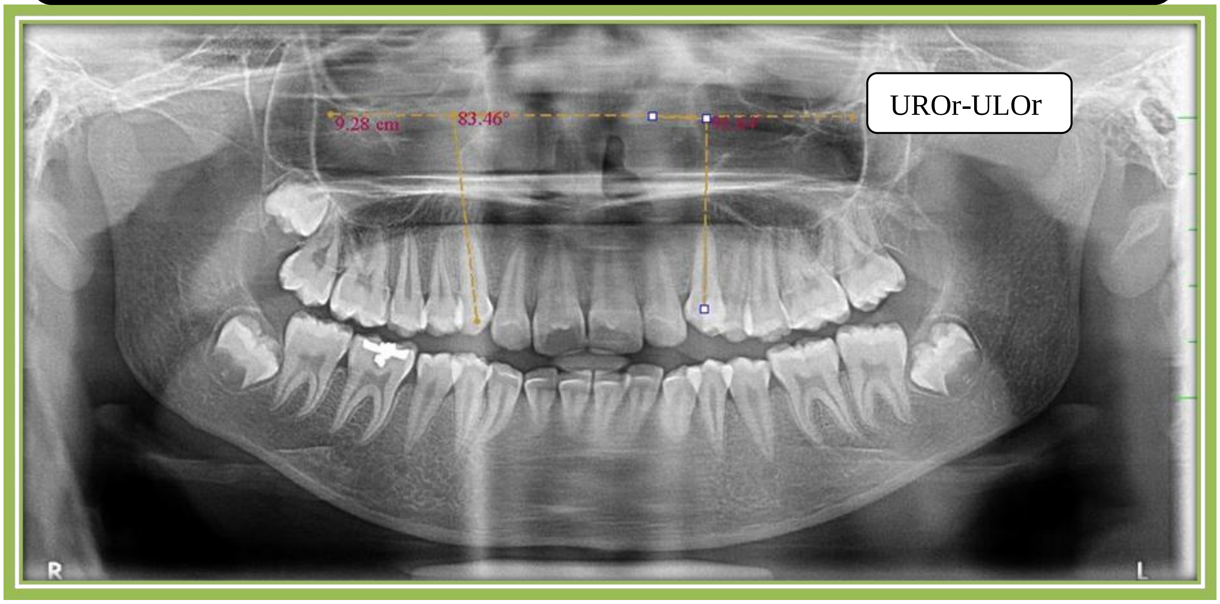


Fig 7- CEPHALOSTAT

Fig 8- CBCT device

Fig 9- Method for Panoramic radiographic analysis



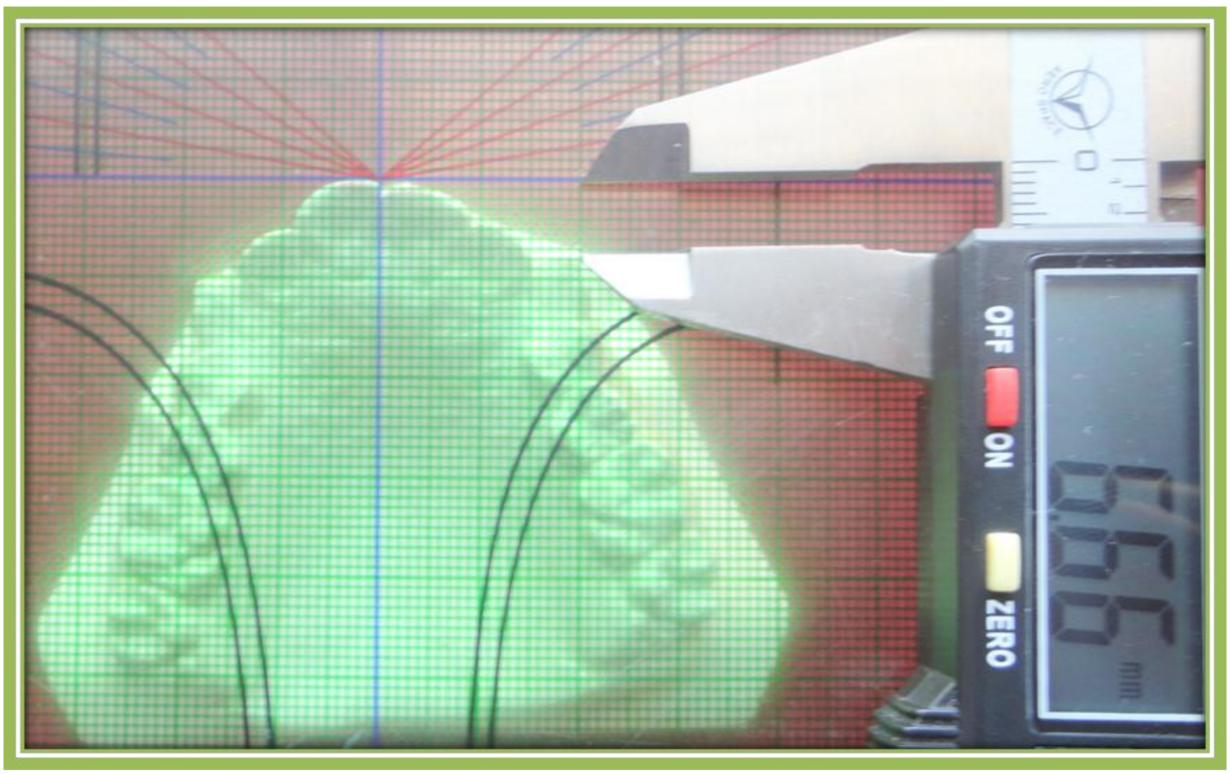


Fig 10 - Method for model analysis with grid and digital Caliper

Fig 11- **Sagittal view of CT section in the region between 2 and 3 in the maxilla with the illustration of the measurement of bone density in the section of alveolar bone, for cancellous bone area. .**

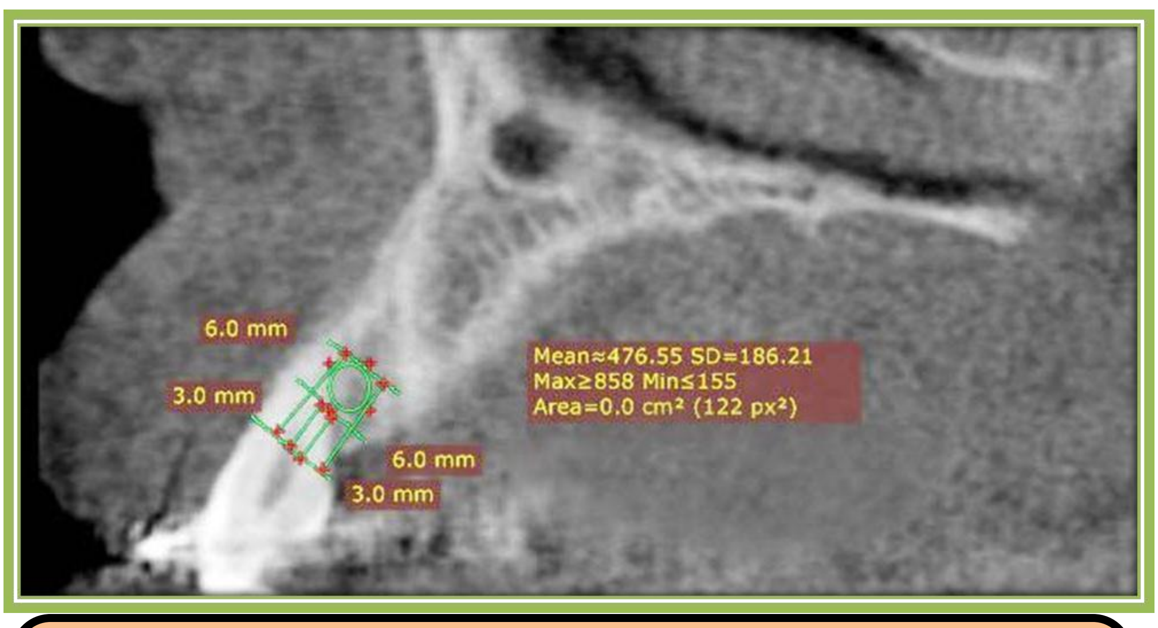


Fig 12 - **Magnified sagittal view of CT section in the region between 2 and 3 in the maxilla. Elliptical area between the green line measures the mean bone density in that area**

Fig 13 Method for model analysis

Fig 14 Bone socket deepening during the PD surgical procedure

Fig 15 –Extracted premolar during surgical procedure

Fig 16 – Gutta-percha as a guide for deepening premolar socket

Fig 17 – occlusal view of modified hyrax palatal distractor.

Fig 18 - Right side view of modified hyrax distractor.

Fig 19 – Left side view of modified hyrax distractor.

In the present study, 20 canines were distracted in 10 patients with intraoral single palatal distractor. One patient reported with facial oedema after the surgery. Due to palatal appliance patient had difficulty in speech and swallowing which subsequently minimized in few days. Mild discomfort was reported by the patient during activation of screw used for distraction procedure which lasted for few seconds.

$$\text{Rate of canine retraction} = \frac{\text{Mesio -distal width of first premolar}}{\text{Duration of canine retraction}}$$

STATISTICAL ANALYSIS

The findings of measurements were analysed statistically. Mean, standard deviation and standard error were calculated for rate of canine retraction, anchor loss, angular change in canine and bone density between lateral and canine Statistical significance between the values of the distracted segment before and 3 months after distraction and angular change in canine pre-distraction and post-distraction were assessed.

- The canine retraction was completed in 15 to 18 days (mean 16.7±1.06).
- The rate of canine retraction range from 0.38mm/day to 0.56mm/day (mean 0.469±0.046)
- Anchor loss of molar range from 0 mm to 2mm (mean 0.7 ± 0. 67)
- The axial inclinations of the canines and molars were measured on the panoramic radiographs taken before and after the distraction, and the data obtained were analyzed by Mann-Whitney U-test.

- The minimum of 5.4^0 and maximum of 18.3^0 (mean11.71 ± 3.47) canine tipping change was observed after distraction. Angular change of canine pre-distraction and post-distraction was statistically significant with a p value of 0.00($P<0.05$).

- Mean Bone density in Hounsfield units between upper lateral and canine before distraction was 455.84±105.24.

- Mean Bone density in Hounsfield units between upper lateral and canine 3 months post-distraction was 453.37± 111.99.

- Mean bone density change pre-distraction and after 3 months of distraction were compared statistically by paired t test which revealed that the value is not significant with p value 0.384 ($p<0.05$).

Table 1 **RATE OF CANINE RETRACTION**

Patient code no.	Mesio -distal width of first premolar	Duration of canine retraction	Rate of canine retraction
RCR-1	8mm	18days	0.45mm/day
RCR-2	8mm	16days	0.5mm/day
RCR-3	7mm	18days	0.38mm/day
RCR-4	8mm	17days	0.47mm/day
RCR-5	8mm	16days	0.5mm/day
RCR-6	7mm	15days	0.47mm/day
RCR-7	8mm	18days	0.45mm/day
RCR-8	7mm	16days	0.44mm/day
RCR-9	9mm	16days	0.56mm/day
RCR-10	8mm	17days	0.47mm/day

-

TABLE 2 **DURATION OF CANINE RETRACTION**

Patient code no.	GROUP
RCR-1	18days
RCR-2	16days
RCR-3	18days
RCR-4	17days
RCR-5	16days
RCR-6	15days
RCR-7	18days
RCR-8	16days
RCR-9	16days
RCR-10	17days

TABLE 3 **ANCHOR LOSS**

Patient code no	Distal movement of canine	Mesial movement of molar	Anchorage loss
RCR-1	8mm	1mm	1mm
RCR-2	9mm	1mm	1mm
RCR-3	7mm	1mm	1mm
RCR-4	6mm	0mm	0mm
RCR-5	8mm	0mm	0mm
RCR-6	6mm	0mm	0mm
RCR-7	8mm	2mm	2mm
RCR-8	9mm	1mm	1mm
RCR-9	7mm	1mm	1mm
RCR-10	7mm	0mm	0mm

TABLE 4 ANGULAR CHANGE IN CANINE BEFORE AND AFTER DISTRACTION

Patient code no.		Pre-DAD(degree)	Post-DAD (degree)	Angular change (degree)
RCR-1	13	83.5	100	16.5
	23	91.6	97.1	5.4
RCR-2	13	84.6	98.3	13.7
	23	87.5	101.8	14.3
RCR-3	13	87.8	100.3	12.5
	23	86.3	102.5	16.2
RCR-4	13	88	96.4	8.4
	23	89.2	98.3	9.1
RCR-5	13	90.1	101.5	11.4
	23	90	102.2	12.2
RCR-6	13	85.4	93.6	8.2
	23	86.2	95.5	9.3
RCR-7	13	85.8	102.2	16.4
	23	85.3	103.6	18.3
RCR-8	13	88.2	98.5	10.3
	23	88.7	99.7	11
RCR-9	13	90.2	100.8	10.6
	23	91.2	100.1	8.9
RCR-10	13	87.6	95.2	7.6
	23	87.4	101.3	13.9

TABLE 5

BONE DENSITY CHANGES BEFORE AND AFTER 3 MONTHS OF DISTRACTION

		Bone density before distraction		Bone density 3 MONTHS AFTER distraction	
		mean	STD DEVIATION	MEAN	STD DEVIATION
1	RT	449.6	102.5	413.1	93.9
	LT	488.8	184.9	476.5	186.2
2	RT	426.8	121.3	423.4	152.5
	LT	435.2	92.5	423.8	102.4
3	RT	453.1	98.6	456.7	95.2
	LT	456.3	87.3	460.2	117.8
4	RT	486.1	72.4	473.1	92.9
	LT	423.1	164.2	434.3	115.5
5	RT	444.3	103.8	421.3	93.6
	LT	498.2	83.2	493.7	103.5
6	RT	483.2	121.2	474.6	101.4
	LT	421.2	100.2	431.7	105.4
7	RT	458.2	102.5	459.3	112.3
	LT	432.8	76.2	427.7	116.2
8	RT	502.3	89.5	512.3	109.5
	L T	458.9	99.2	457.6	109.2
9	RT	478.6	98.3	487.2	103.3
	LT	467.9	100.4	477.7	109.4
10	RT	421.1	104.2	427.1	107.2
	LT	431.2	102.4	436.2	112.4

STATISTICAL ANALYSIS TABLES

RATE OF CANINE RETRACTION

TABLE 6

	n	mean	Std deviation	Standard error
Duration of canine retraction in days	10	16.7	1.06	0.33
Mesio -distal width of right first premolar	10	7.80	0.632	0.20
Rate of canine retraction in mm/day	10	0.469	0.046	0.0145

ANCHORAGE LOSS OF MOLAR

TABLE 7

	n	mean	Std deviation	Standard error
Distal movement of canine	10	7.5000	1.08012	.34157
Mesial movement of molar	10	.7000	.67495	.21344
Anchorage loss	10	.7000	.67495	.21344

ANGULATION OF CANINE

TABLE 8

	Mean	n	Std. Deviation	Std. Error Mean	Sig. (2 tailed)
PRE-DISTRACTION	87.7300	20	2.23138	.49895	.0000
POST-DISTRACTION	99.44	20	2.75671	.61642	
ANGULAR CHANGE	11.7100	20	3.47304	.77660	

BONE DENSITY BETWEEN LATERAL AND CANINE **TABLE 9**

	n	Mean	Std. Deviation	Std. Error Mean	Sig. (2 tailed)
PRE-DISTRACTION	20	455.8450	105.2400	5.94885	0.384
3 MONTH AFTER POST-DISTRACTION	20	453.3750	111.9900	6.32899	

CASE REPORT (Fig-20)

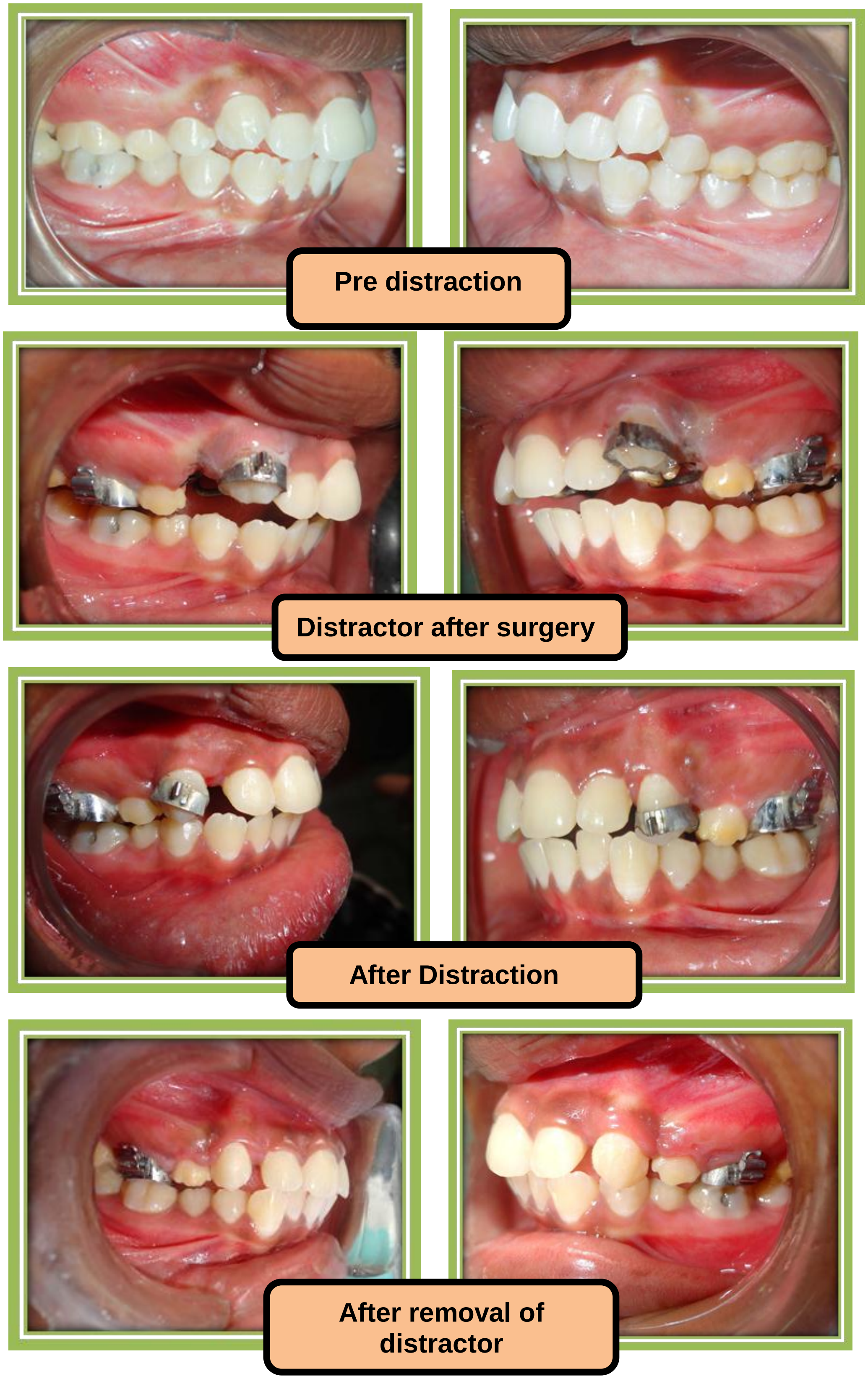


Fig 21- OCCUSAL VIEW

Predistraction

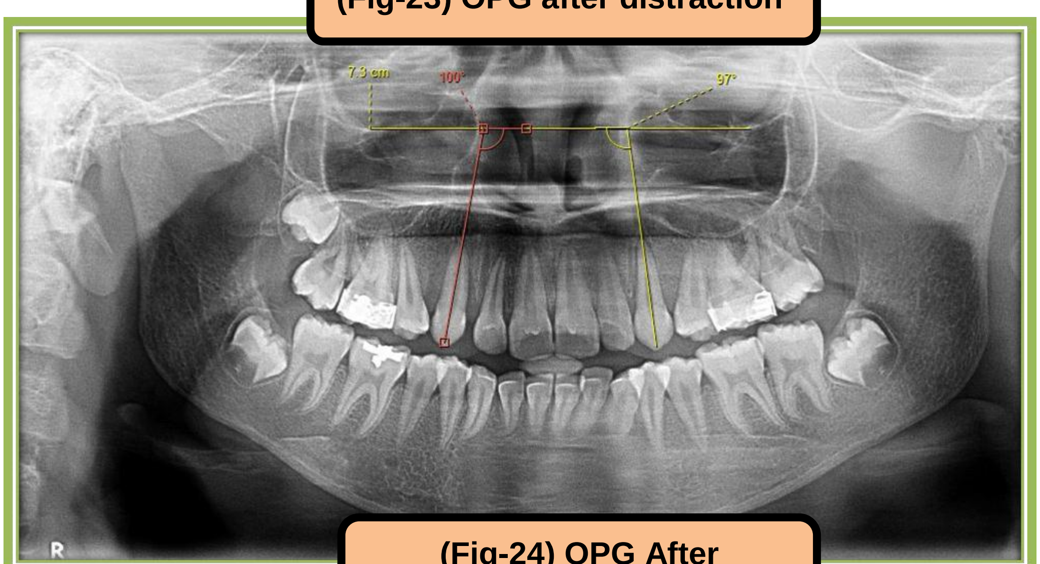
Distractor after surgery

Post-distraction with distractor

Post-distraction without distractor

(Fig-22) Predistraction OPG

(Fig-23) OPG after distraction



(Fig-24) OPG After distraction removal

(Fig-25) PREDISTRACTION MODEL

(Fig-26) POSTDISTRACTION MODEL

Orthodontic therapy depends on the biological response to the orthodontic forces. Orthodontic tooth movement is a process in which a mechanical force is applied to induce alveolar bone resorption on the pressure side, and alveolar bone deposition on the tension side[28]. As the tooth movement takes place, the attachment apparatus along with the socket is arranged and remolded. The bony response is mediated by periodontal ligament and tooth movement continues as a periodontal phenomenon. Contemporary orthodontic treatment uses either fixed or functional appliances. Using contemporary techniques, biological tooth movement can be achieved at a limited rate[36]. Individual factors such as optimum force, rate of turnover of cells of periodontal ligament, and bone metabolism play an important role in determination of rate of tooth movement. The time required for tooth movement within the alveolar bone may lengthen the overall orthodontic treatment time[25].

In conventional orthodontics, the tooth movement occurs at a rate of 1mm per month. Therefore, in cases where premolar extractions are necessary as a part of orthodontic treatment plan, the canine distalization period takes 6-8 months. Numerous surgical and nonsurgical modalities have been advocated to hasten the tooth movement. Corticotomy-assisted orthodontics has been suggested for reducing orthodontic treatment time. Gantes et al showed that the mean orthodontic treatment duration was 14.8 months in the corticotomy-assisted group and 28.3 months in the control (without corticotomy) group[12]. Chung et al stated that the combined use of orthopaedic traction and corticotomy procedures can be effective for anterior retraction and posterior intrusion, alongwith reduction of the orthodontic treatment time[26]. Apart from its enumerable advantages, the main but rare disadvantages of corticomy-assisted orthodontics included periodontal pocket formation, localized bone loss as well as swelling in the vestibular region.

Distraction osteogenesis is an emerging technique to accelerate the tooth movement. It is a process whereby new bone is grown by mechanically stretching a pre-existing bone tissue[35]. It was made popular in studies by Ilizarov[17], who showed in many patients that new bone could be formed after surgical corticotomy followed by distraction osteogenesis. The similar concept was first introduced for canine distalization by periodontal distraction by Liou and Huang et al[28] in 1998. Studies of rapid canine distalization were limited because the technique was primarily indicated in adults who require maximum anchorage control. The lag period concept is used for controlling the anchorage of posterior teeth, and the philosophy of canine distraction can be summarized as rapid distalization of the canines through the extraction socket while the posterior teeth are still in a lag period and before the orthodontic forces causes' anchorage loss and undesired root resorption[40]. The two main aims of the present study were to minimize the orthodontic treatment time and to control the anchorage loss with minimum damage to the supporting structures. The present study was carried out to evaluate the rate of tooth movement, axial change in canine, anchorage loss, root resorption, and qualitative bone density changes using cone beam computed tomography in rapid canine distraction.

The rate of osteogenesis in orthodontic tooth movement during canine retraction is usually about 1mm per month. However it has been shown that following the DO, the movement of a tooth into the newly created fibrous bony tissue could increase as much as 1.2mm per week[27]. After the 1st premolar extraction, vertical osteotomies were carried out at the interseptal bone adjacent to the canine. The distractors were immediately cemented in place after surgery.

Till date two types of canine distraction, periodontal distraction (PD) and dentoalveolar distraction (DAD) have been mentioned in the literature. Liou and Huang et al[28] introduced the method of canine distalization by periodontal ligament distraction after premolar extraction and termed it as “dental distraction”. After, the first premolar extraction, a round carbide bur was used to increase the depth of the premolar socket. The bone in the premolar socket was grooved vertically along the buccal and lingual sides, extending obliquely toward the base of the interseptal bone to weaken resistance. This was followed by the oblique undermining groove connecting the vertical undermining grooves at the base of the prepared socket with a custom-made angled osteotome. In 2002, Kisnisci et al[25] introduced another technique for rapid canine retraction. In this approach, which was known as dentoalveolar distraction (DAD), the segment that contained the canine was transported as a bone block. It differed from the technique advocated by Liou and Huang[28] to the extent that the periodontal ligament is not stretched. They performed a bone separation from the bone block containing the canine using corticotomies to allow the tooth to move along with the bone that surrounds it through a distraction osteogenesis process.

Periodontal distraction is a simple surgical procedure without elevation of flap and removal of buccal bony plate thus minimizing the surgical complications. With the aid of radiography such as CBCT it becomes possible to accurately determine how much the alveolus needs to be deepened in order to completely eliminate any interference with canine movement. It renders the surgical procedure much faster and safer. It also provides an assessment of sinus and nasal floor proximity, enabling professionals to determine in advance the maximum drill length to be employed[35].

In the present study, 20 canines were successfully distalized with the help of single mid palatal modified hyrax distractor, till space closure was achieved distal to canine, within 3 weeks using periodontal distraction (PD) method.

Buccal v/s palatal distractor

Faber described the fabrication of a buccal distractor from a conventional Hyrax expander by sectioning longitudinally one of the rods of the Hyrax followed by rounding of the sharp edges. This buccal distractor was used on both sides individually to distract the canine. A number of custom made distractors were used in many studies. Use of buccal distractors result in 15 to 20 degrees of canine inclination during distalization[35]. This inclination, which decreases root apex movement and in turn reduces neurovascular bundle stretching may explain why no endodontic complications arise when using this technique. In the vertical plane, a significant extrusion of canines during retraction was clinically observed. In the transverse plane, with the use of distractors placed through buccal access, distal rotation and canine proclination was observed. Since the distractor is positioned too buccally relative to the center of resistance of the canine, it depicts a movement with distal rotation and buccal inclination. In the upper arch, the main side effect was buccal inclination, and the amount of inclination was directly related to the initial position of canines in the transverse plane, i.e., the more buccal, the greater the final inclination. In the lower arch, the main side effect was distal rotation with mild buccal proclination.

Hence for the buccally inclined or buccally placed canine in the maxillary arch, buccal distractor would be detrimental to the thin buccal bony plate. In order to avoid proclination of the maxillary canines during RCR in these cases, some changes were proposed in which distractors were fabricated and placed as a measure to prevent buccal inclination of the canines and thus preserve the thin buccal bone plate. Single mid palatal distractor was used in the study with periodontal distraction to evaluate its effect on buccally inclined canine during distraction. Palatal distractor is made from a fully opened Hyrax screw without any clipping; just turning it 90 degrees allows it to be used for retraction. The distractor is selected according to the number of millimeters that one wishes the canines to distalize, plus at least 2 mm. In our study a 13 mm screw was used, which due to its greater length provided greater stability after opening. Proper polishing was required to ensure greater patient comfort. Bands were fabricated for the canines and first molars, and a transfer impression was made to allow the welding of the distractor to the bands once these were positioned on the working model. The original arrow on the screw should be pointing towards occlusal to facilitate activation and prevent forces from moving the distractor during the activation process. Thus, as activations will be made in the opposite direction of the arrow, it decreases the likelihood that the device be displaced. After verifying that the distractor was properly installed the screw was once again completely closed and opened and was sterilized before the final cementation.

DURATION OF CANINE RETRACTION

With conventional orthodontic treatment canine distalization takes more than 6 months[45]. Rapid canine distalization with the distraction of the periodontal ligament reduces the treatment time, and both the upper and lower canines can be distracted successfully in three weeks with controlled distal tipping[40].

In the present study, clinically desired retraction of canine was achieved simultaneously on both sides of maxillary arch. The mean canine retraction time was approximately 16.70±1.06 day and the distraction procedure was completed minimum in 15days to maximum 18days.Yusuf Sukuricahe et al reported dentoalveolar distraction procedure with buccal modified hyrax which was completed in 12 to 28 days (mean 14.65± 3.49)[49]. Liou and Huang demonstrated that in periodontal distraction, both the upper and lower canines were distracted distally into the first premolar extraction sockets 6.5 to 6.6 mm in 21 days (3 weeks)[28].

Rate of canine retraction

Hyalinization of periodontal fiber bundles on the pressure side occurs more frequently during the initial stage than later on. This is caused partly by the density of the inner alveolar bone, along which extensive cell-free areas may be formed. Hence, light forces are applied during the initial stage of tooth movement to reduce the formation of cell-free, hyalinized areas. The tendency of such formation decreases as soon as this compact bone plate has been eliminated by resorption[24]. In the present study immediately after the 1st premolar extraction, vertical osteotomies were carried out at the interseptal bone adjacent to the canine tooth

In comparison to premolar roots, canine roots are much longer. Therefore, soon after the premolar extraction, the vertical length of socket was increased till the apex of canine root and an oblique cut was made just below the canine root with the help of a bone cutting bur. The bone on buccal and lingual sides of canine was weakened so that canine could move easily in the premolar socket when force was applied. Less than 50% of time duration was reduced in comparison with conventional space closure method. This is because, the orthodontic tooth movement is faster in an alveolar bone with loose bone trabecular and less bone resistance.

The regenerative bone tissue refills the extraction socket in 3 week time and becomes resistant in 3 months. If the canine is not retracted within this period the rate of tooth movement will slow down, the root surface resorption will increase, and anchor unit will start to move forward[20].

The periodontal ligament is essentially a hydrostatic system maintained by blood pressure of the capillary bed. A force in excess of 26 g/cm^2 was estimated to strangulate the periodontal tissues, forcing the tooth into physical contact with the alveolar bone and causing necrosis. The initial obstacle to orthodontic tooth movement is the necessary elimination of the necrotic (hyalinizing) tissues by undermining resorption. The elimination of the hyalinizing tissues takes 2 to 3 weeks, which is known as the lag period[28].

Various studies by Liou et al[28], Cope et al[20], Reha et al[37], Sehar et al[40], Osman et al[33], Tav Lva et al[44] and Gokmen et al[13] have been conducted by using distraction screws, and distalizing canine within 3 weeks. Tooth-borne, custom-made, intraoral distraction device are necessary to distract the canine distally into the extraction space. Pain and discomfort due to the bulkiness of the distraction appliance along with ulceration of buccal mucosa as well as a feeling of pressure on teeth for a short duration caused due to activation of screw are often reported by the patients[35]. In the present study these problems were overcome as the appliance used was Palatal distractor.

In the present study the rate of canine distalization was 0.469±0.046 mm per day. It shows that rate of canine distalization, when the bone distal to canine is weakened ,was faster as compared to conventional method in which the rate of retraction is 1 mm per month.

ANGULAR CHANGE OF CANINE

Axial inclination of canine depends on type of distraction (surgery) and type of distractor. Sayin, Bengi et al[40] reported 11.47^0 of distal tipping of canine in the adult patient with periodontal ligament distraction with custom made buccal distractor. According to V. R. Kharkar et al[45] average canine tipping with buccal custom made periodontal distraction is 15.33±0.27 and with buccal custom made dentoalveolar distraction is 10.61±0.29. Iseri and kisnisci et al[18] reported mean change in canine inclination of $13.15^{o}+4.65^{o}$ at the end of the distraction period with dentoalveolar distraction osteogenesis.

However, despite the efforts to attain parallel canine movement, in the present study 11.7±3.47 of distal tipping had occurred in patients which are comparable with the other PD studies.

<u>Anchor loss</u>

Hixon et al stated that after the initial tooth movement, a lag period of minimal tooth movement persists for approximately 2 to 3 weeks before the tooth movement proceeds again. The initial obstacle to orthodontic tooth movement is the necessary elimination of the necrotic (hyalinizing) tissues by undermining resorption. The elimination of the hyalinized tissues takes around 2 to 3 weeks time. Any technique that takes longer than 3 weeks to retract a canine will result in loss of anchorage. Not only the canine but also the anchor unit will move towards each other after the lag period. In this study, the canine distraction was completed while the first molar was still in its lag period or just initiating its mesial movement.

Enumerable methods like transpalatal appliance, Nance palatal appliance, headgear, miniimplant anchorage have been used till now to preserve the anchorage, but none had given satisfactory result in high anchorage cases. Rapid Canine distraction is one of anchorage preservation technique with minimum mesial movement of molar and maximum distal movement of canine.

It has been reported that during distraction, 73% of the first molars did not move mesially and 27% of them moved less than 0.5 mm mesially within 3 weeks[28]. Yusuf Sukurica et al[49] reported the anchorage loss ranged from 0 to 3 mm (mean 1.2±0.834).In the present study anchorage loss ranged from 0 mm to 2mm (mean 0.7 ± 0. 67) which is in corroboration with other studies.

Buccal inclination of maxillary canine

With the use of distractors placed through buccal access, canine proclination was observed. Since the distractor is positioned too buccally relative to the center of resistance of the canine, it depicts a movement with distal rotation and buccal inclination. In the upper arch, the main side effect was buccal inclination, and the amount of inclination was directly related to the initial position of canines in the transverse plane, i.e., the more buccal, the greater the final inclination. In the present study, the intercanine width measured pre and postdistraction were same or mildly reduced. This led to the inference that as the appliance was placed palatally, which is closer to the center of resistance, buccal inclination of canine remained same or reduced after rapid canine distraction which in turn was desired in the buccally inclined or buccally placed canine. Hence the thin buccal alveolar plate was preserved[35].

Bone density of the distracted segment by cone beam tomography

More recently, radiographic imaging techniques, such as digital ortho pantamography radiography, cone beam computed tomography (CBCT), ultrasonography, dual-energy X-ray absorptiometry (DEXA), magnetic resonance imaging (MRI) have become necessities in the assessment of jaw bone to evaluate the treatment effectiveness preoperatively and to decrease the recovery time

According to liou and huang, the radiographic changes in the intra oral periapical radiograph (IOPA) of the periodontal ligaments on the mesial side of the canines could be classified into five stages, from the initiation of the distraction to the complete remodeling of the new alveolar bone[28].

Stage 1. In the first week after initiating the distraction, stretching and widening of the periodontal ligament without evidence of Bone formation.

Stage 2. In the second week, active growing of striated bone (new bone spicules) in the distracted periodontal ligament

Stage 3. In the first to fourth week after completing the distraction, recovery of the distracted periodontal ligament. The striated bone became denser and the distracted periodontal ligament gradually decreased in width and back to normal.

Stage 4. From the fourth week to the third month after completing the distraction, remodeling of the striated bone occurs. The striated bone eventually becomes the new lamina Dura on the mesial side of the canine. The radio density of the remodeling striated bone was similar to the cancellous alveolar bone. The native lamina Dura disappeared gradually.

Stage 5. Maturation of the striated bone was 3 months after completing the distraction. The native lamina Dura disappeared and the new lamina Dura was of normal thickness.

On the radiographs, the interseptal bone between the lateral incisor and the canine was indistinguishable from the other interseptal bones.

CBCT has revolutionized the bone analysis and treatment planning. With a single scan and a low dose of radiation, images of both bone and soft tissues are analyzed. CT creates a three-dimensional reconstruction of the patient's skull or of any maxillofacial region. Moreover, this technique is able to produce images in axial, sagittal, and frontal planes.

Liou and huang had studied maturation of distracted segment radiographically in the IOPA which was 2 dimensional and stated that full maturation of distracted segment occurs in 3 months. For obtaining a 3 dimensional view and to evaluate the bone maturation after 3 months of distraction qualitatively, cone beam computed tomography was used in the present study. Bone density was measured in Hounsfield unit pre and post distraction (after 3 months)

The pre and the post distraction Mean bone density were 455.84±105.24 and 453.37±111.99 respectively. Difference between the two was non significant statistically which shows that after 3 months of distraction, maturation of the bone had taken place as it was before distraction. It was **also concluded** that retraction of anterior teeth immediately after distraction is possible and can be completed in 3 months or less with a rapid rate as the distracted bone would take 3 months to mature. Consolidation period can be extended after distraction to prevent the relapse of the distalized canine.

Reaction to Pulp Vitality tester

Pulp vitality test for the tooth undergoing orthodontic treatment is not reliable. The effects of distraction on pulp vitality of the canines cannot be accurately determined by the electronic pulp tester. Laser Doppler flowmetry may be a more reliable method in detecting blood flow in the pulp tissues of those teeth undergoing distraction. Even though the major vessels to the tooth pulp are cut, less than 2o/o of the involved teeth require endodontic treatment. Even if the apex of a tooth is inadvertently cut off, pulp vitality is likely to be maintained by blood flow through auxiliary foraminae[36].

In the present study, electronic pulp tester was used pre distraction and after every 15 days till 3 months of distraction period. No abnormal reaction of the tooth was seen during pulp testing. Discoloration of canine or anchorage teeth was not seen clinically. No endodontic and periodontic lesions were seen radiographically.

Root resorption and ankylosis

A certain degree of root resorption will occur in patients undergoing orthodontic treatment and duration of the applied force is one of the most important aggravating factors for the root resorption. Duration of force is regarded as a more critical factor than its magnitude[15,42]. External root resorption is initiated 2 to 3 weeks after the orthodontic force is applied and may continue for the duration of force application. The best way to minimize the root resorption induced by orthodontic tooth movement is to complete the tooth movement in a short duration or even before initiation of root resorption. In this study, the canine distraction was completed within 3 weeks while the root resorption was just initiating.

In the present study the periodontal ligaments were patent and the canines responded to orthodontic forces after the distraction. However, the long-term effects of canine distraction (rapid canine retraction) are currently not well known and need close monitoring.

Rapid canine distalization through periodontal ligament distraction is a clinically efficient method that significantly reduces the overall treatment time without causing any serious discomfort or damage to the patient. It reduces overall treatment time by 6-9 months.

Canine distraction is primarily indicated in adults presenting bimaxillary protrusion, a Class II division 1 malocclusion with maxillary dentoalveolar excess or anterior crowding. When maximum anchorage is required, it can also be used in the treatment of adolescent patients with anterior crowding. Since last 15 years, modification and customization were advocated for the buccal distractor in enumerable studies. Main shortcoming of buccal distractor was buccal inclination and distal rotation of canine after distraction.

The present study was undertaken to evaluate the effect of rapid canine distraction with single mid palatal distractor in buccally inclined canine.

Following conclusion had been drawn from the study

- Duration canine retraction was in 15 to 18 days (mean 16.7±1.06).
- The rate of canine retraction was 0.38mm/day to 0.56mm/day (mean 0.469 ±0.046)
- Anchorage loss range from 0 mm to 2mm (mean 0.7 ± 0. 67)
- The minimum of 5.4^0 and maximum of 18.3^0 (mean11.71 ± 3.47) canine tipping change was observed after distraction. Angular change of canine pre-distraction and post-distraction was statistically significant.

- Mean Bone density in Hounsfield units between upper lateral and canine before distraction was 455.84±105.24 and after 3 months post-distraction was 453.37± 111.99 which concludes that bone gets mature within 3 months after distraction to the same level as it was previously.
- Buccal inclination of canine remained the same or reduced after distraction.
- Rate of canine retraction, anchor loss, angular change in canine is comparable with buccal distractor used in other studies.
- No root resorption, ankylosis or loss of pulp vitality was recorded the study. The relevant teeth must be closely monitored during the distraction period

The long term effects of periodontal Distraction Osteogenesis are unknown and need close long term monitoring. Further research is needed to know the rate and thickness of bone maturation at the site of distraction at histological level, Vitality, anchorage loss during anterior retraction, rate of space closure in the newly formed unmineralized bone.

A long term study on a bigger sample size is required before accepting the concept of mid palatal distractor with periodontal distraction and its implementation in routine orthodontic practice.

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ஆராய்ச்சி ஒப்புதல் படிவம்

ஆராய்ச்சி தலைப்பு

ஒற்றை அண்ண எலும்பு இழுவிசை கருவி கொண்டு அறுவை சிகிச்சையின் உதவியால் கோரை பற்களை வேகமாக பின் இழுத்து பிறகு சிறப்பு எக்ஸ்-ரே (சிபிசிடி) மூலம் எலும்பின் அடர்த்தியை அறியும் ஆய்வு

பெயர்	:	தேதி	:
வயது	:	உள் / புற நோயாளி எண்	:
பால்	:	ஆராய்ச்சி சேர்க்கை எண்	:

என்னுடைய சுய நினைவுடனும் மற்றும் முழு சுதந்திரத்துடன் இந்த மருத்துவ ஆராய்ச்சியில் சேர்ந்துக்கொள்ள ஒப்புதல் அளிக்கிறேன்.

கீழ்காணப்படும் நிபந்தனைகளுக்கு நான் ஒப்புதல் அளிக்கிறேன்.

இந்த ஆராய்ச்சியின் நோக்கமும் அறுவை சிகிச்சை முறைகளும் எனக்கு திருப்தியளிக்கும் வகையில் அறிவுறுத்தப்பட்டது.

இது சிறு அறுவைசிகிச்சை என்றும், சிகிச்சையின்போது முதல்முன்கடவாய் பல்லில், பல் எடுக்கும் இடத்தில் மரத்துப்போகும் ஊசி போடப்படும் என்பதை அறிந்து கொண்டேன்.

முதல் முன்கடவாய் பல் எடுத்த குழியில் கன்னத்துப் பகுதியிலும், அன்னப்பகுதியிலும் செங்குத்தாய் ஒரு வெட்டும் அதற்கு சாய்வாக மற்றொரு வெட்டும் போடப்பட்டு இரண்டு வெட்டுகளும் இணைக்கப்படும் என்பதை அறிந்து கொண்டேன். அதன்பிறகு இரண்டு பற்களுக்கு நடுவில் உள்ள எலும்பின் திடத்தை குறைத்து கோரை பற்களை வேகமாக பின்இழுக்கப்படும் என்பதை அறிந்து கொண்டேன்.

இந்த சிகிச்சையானது நான்கு வாரங்கள் நடத்தப்படும் என்பதையும் அறிந்து கொண்டேன்.

என் உடல்நலம் பாதிக்கப்பட்டாலோ அல்லது எதிர்பாராத வழக்கத்திற்கு மாறான நோய்அறிகுறி தென்பட்டாலோ அதனை உடனடியாக மருத்துவரிடம் தெரிவிக்க சம்மதிக்கிறேன்.

…………………………	…………………………	…………………………
நோயாளியின் பெயர்	கையொப்பம்	தேதி
…………………………	…………………………	…………………………
நோயாளியின் பெற்றோர் பெயர்	கையொப்பம்	தேதி
…………………………	…………………………	…………………………

INFORMED CONSENT FORM

STUDY TITLE: Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT).

Name: O.P No.

Address: Code No.

Age/Sex:

I, ____age____years

Exercising my free power of choice, hereby give my consent to be included as a participant in the study Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT)...

I agree to the following:

- I have been informed to my satisfaction about purpose of study procedure including surgical procedure for canine retraction.
- I understand that the minor surgical procedure is done under local anaesthesia as outpatient patient basis for extraction of first premolar and a osteotomy (surgical cut given in alveolar bone) cut done in buccal and lingual distal interseptal bone of canine inside the first premolar socket and one oblique groove horizontally to join the two cut for rapid retraction of canine by palatal distraction device. This study is of four week duration.
- I agree to cooperate fully and to inform my doctor immediately if I suffer any unusual symptom.
- I hereby give permission to use my medical records for research purpose. I am told that the investigating doctor and institution will keep my identity confidential.

Name of the patient: patient signature/Thumb impression

Name of the parent: parent signature/thumb impression

Name of the investigator signature/Date

<u>தகவல் அறிக்கை</u>

நாங்கள் ஒற்றை அண்ண எலும்பு இழுவிசை கருவி கொண்டு அறுவை சிகிச்சையின் உதவியால் கோரை பற்களை பின் இழுத்து பிறகு சிறப்பு எக்ஸ்–ரே (சிபிசிடி) மூலம் எலும்பின் அடர்த்தியை அறியும் ஆய்வின் தமிழ்நாடு அரசு பல் மருத்துவக் கல்லூரி மற்றும் மருத்துவமனையில் மேற்கொள்கிறோம். இந்த ஆய்விற்காக நோயாளிகளை தேர்வு செய்து வருகின்றோம்.

இந்த ஆராய்ச்சியில் பங்கேற்கும் நோயாளிகளின் விபரங்கள் ஆய்வு முடியும் வரை இரகசியமாக வைக்கப்படும். ஆராய்ச்சியின் முடிவு பற்றிய பதிப்புகள் அல்லது வெளியீடுகளில் யாருடைய தனிப்பட்ட விவரங்களும் பகிர்ந்து கொள்ளப்படமாட்டாது.

இந்த ஆராய்ச்சியில் பங்கேற்கும் உங்கள் முடிவு தன்னிச்சையானது, இந்த ஆராய்ச்சியில் பங்கேற்கும் எந்த நேரத்திலும் விலக்கிக் கொள்வதற்கும் உங்களுக்கு வாய்ப்பு உள்ளது. உங்களின் இந்த தீர்மானத்தினால் உங்களுக்கு இம்மருத்துவமனையில் வழங்கப்படும் பயன்களில் எவ்வித மாற்றமும் இருக்காது.

இந்த சிறப்பு ஆய்வின் முடிவுகள், இந்த ஆய்வின் முடிவில் அல்லது ஆய்வின்போது ஏற்படும் எதிர்மறையான விளைவுகளை அந்நோயாளியின் நலன் கருதியோ அல்லது சிகிச்சையளிக்கும் பொருட்டோ நோயாளிக்கு தெரிவிக்கப்படும்.

ஆய்வாளரின் கையொப்பம் **நோயாளியின் கையொப்பம்**

தேதி

INFORMATION SHEET

- We are conducting a study on Rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography (CBCT) among patients attending TNGDCH, Chennai and for that study we are selecting patients.
- The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.
- Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.
- The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of investigator   Signature of participant

Date:

INSTITUTIONAL ETHICAL COMMITTEE

Tamil Nadu Government Dental College and Hospital, Chennai - 3
Telephone No. 044 2534 0343
Fax 044 2530 0681

Ref.No.0430/ DE/ 2010

Date: 26.11.2012

Title of the work: "Effects of rapid canine distalization through distraction of periodontal ligament using single mid-palatal distractor and comparing bone density of distracted segment by cone beam computed tomography" (CBCT)

Principal investigator: Dr.Rizwan Ahmed,
II Year MDS

Department : Orthodontics,
Tamil Nadu Government Dental College and Hospital, Chennai - 3

The request for an approval from the Institutional Ethical Committee (IEC) considered on the IEC meeting held on 30-04-2012 at the Principal's Chambers Tamil Nadu Government Dental College and Hospital, Chennai – 3 and subsequent to your modification letter dated 26,11,2012

"Advised to proceed with the study"

The Members of the Committee, the secretary and the Chairman are pleased to approve the proposed work mentioned above , submitted by the principal investigator.

The principal investigator and their team are directed to adhere the guidelines given below:

1 .You should get detailed informed consent from the patients / participants and maintain confidentiality

2. you should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.

3 You should inform the IEC in case of any change of study procedure , site and investigation or guide.

4. You should not deviate from the area of work for which you have applied for ethical clearance

5. You should inform the IEC immediately in case of any adverse events or serious adverse reactions. You should abide to the rules and regulations of the institution (s)

6. You should complete the work within the specific period and if any extension of time is required, you should apply for permission again and do the work.

7 .You should submit the summary of the work to the ethical committee on completion of the work.

8. You should not claim funds from the Institution while doing the work or on completion.

9.You should understand that the members of IEC have the right to monitor the work with prior intimation

10. Your work should be carried out under the direct supervision of your Guide / Professor.

Shanmugachand 26/11/12
SECRETARY

26/11/12
CHAIRMAN